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THE

CHEMICAL NEWS

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JOURNAL OF PHYSICAL SCIENCE.

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.



EDITED BY

WILLIAM CROOKES, F.R.S., &c.

VOLUME XXIX.—1874.

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THE CHEMICAL NEWS.

VOLUME XXIX.

EDITED BY WILLIAM CROOKES, F.R.S., &c.

No. 736.—FRIDAY, JANUARY 2, 1874.

ON THE ACTION OF HEAT ON GRAVITATING MASSES.*

By WILLIAM CROOKES, F.R.S., &c.

THE experiments recorded in this paper have arisen from observations made when using the vacuum-balance, described by the author in his paper "On the Atomic Weight of Thallium,"† for weighing substances which were of a higher temperature than the surrounding air and the weights. There appeared to be a diminution of the force of gravitation, and experiments were instituted to render the action more sensible, and to eliminate sources of error.

In an historical *résumé* of the state of our knowledge on the subject of attraction or repulsion by heat, it is shown that in 1792 the Rev. A. Bennet recorded the fact that a light substance delicately suspended in air was attracted by warm bodies: this he ascribed to air-currents. When light was focused, by means of a lens, on one end of a delicately suspended arm, either in air or in an exhausted receiver, no motion could be perceived distinguishable from the effects of heat.

Laplace speaks of the repulsive force of heat. Libri attributes the movement of a drop of liquid along a wire heated at one end, to the repulsive force of heat; but Baden Powell has not succeeded in obtaining evidence of repulsion by heat from this experiment.

Fresnel describes an experiment by which concentrated solar light and heat caused repulsion between one delicately suspended and one fixed disk. The experiment was tried in air of different densities, but contradictory results were obtained, under apparently similar circumstances, at different times, and the experiments were not proceeded with.

Saigey describes experiments which appear to prove that a marked attraction exists between bodies of different temperatures.

Forbes, in a discussion and repetition of Trevelyan's experiment, comes to the conclusion that there is a repulsive action exercised in the transmission of heat from one body into another which has a less power of conducting it.

Baden Powell, repeating Fresnel's experiment, explains the results otherwise than as due to repulsion by heat. By observing the *descent* of the tints of Newton's Rings between glass-plates when heat was applied, Dr. Powell shows that the interval between the plates increases, and attributes this to a repulsive action of heat.

Faye has introduced the hypothesis of a repulsive force of heat to account for certain astronomical phenomena.

He describes an experiment to show that heat produces repulsion in the luminous arc given by an induction-coil in rarefied air.

The author describes numerous forms of apparatus successively more and more delicate, which enabled him to detect, and then to render very sensible, an action exerted by heat on gravitating bodies, which is not due to air-currents, or to any other known force.

The following experiment with a balance made of a straw beam with pith-ball masses at the ends enclosed in a glass tube, and connected with a Sprengel pump, may be quoted from the paper:—

"The whole being fitted up as here shown, and the apparatus being full of air to begin with, I passed a spirit-flame across the lower part of the tube at *b*, observing the movement by a low-power micrometer; the pith-ball (*a, b*) descended slightly, and then immediately rose to considerably above its original position. It seemed as if the true action of the heat was one of attraction, instantly overcome by ascending currents of air. . . .

"31. In order to apply the heat in a more regular manner, a thermometer was inserted in a glass tube, having at its extremity a glass bulb, about $1\frac{1}{2}$ inch diameter; it was filled with water, and then sealed up. . . . The water was kept heated to 70° C., the temperature of the laboratory being about 15° C.

"32. The barometer being at 767 millims., and the gauge at zero, the hot bulb was placed beneath the pith-ball at *b*. The ball rose rapidly; as soon as equilibrium was restored, I placed the hot-water bulb above the pith-ball at *a*, when it rose again, more slowly, however, than when the heat was applied beneath it.

"33. The pump was set to work, and when the gauge was 147 millims. below the barometer, the experiment was tried again; the same result, only more feeble, was obtained. The exhaustion was continued, stopping the pump from time to time, to observe the effect of heat, when it was seen that the effect of the hot body regularly diminished as the rarefaction increased, until when the gauge was about 12 millims. below the barometer the action of the hot body was scarcely noticeable. At 10 millims. below it was still less; whilst when there was only a difference of 7 millims. between the barometer and the gauge, neither the hot-water bulb, the hot rod, nor the spirit-flame caused the ball to move in an appreciable degree. The inference was almost irresistible that the rising of the pith was only due to currents of air, and that at this near approach to a vacuum the residual air was too highly rarefied to have power in its rising to overcome the inertia of the straw beam and the pith balls. A more delicate instrument would doubtless show traces of movement at a still nearer approach to a vacuum; but it seemed evident that when the last trace of air had been

* Abstract of a Paper sent to the Royal Society August 12, 1873.

† *Phil. Trans.*, 1873, vol. clxiii., part 1, p. 277.

removed from the tube surrounding the balance (when the balance was suspended in empty space only), the pith-ball would remain motionless wherever the hot body were applied to it.

"34. I continued exhausting. On next applying heat, the result showed that I was far from having discovered the law governing these phenomena; the pith-ball rose steadily, and without that hesitation which had been observed at lower rarefactions. With the gauge 3 millims. below the barometer, the ascension of the pith when a hot body was placed beneath it was equal to what it had been in air of ordinary density; whilst with the gauge and barometer level its upward movements were not only sharper than they had been in air, but they took place under the influence of far less heat; the finger, for example, instantly sending the ball up to its fullest extent."

A piece of ice produced exactly the opposite effect to a hot body.

Numerous experiments are next given to prove that the action is not due to electricity.

The presence of air having so marked an influence on the action of heat, an apparatus was fitted up in which the source of heat (a platinum spiral rendered incandescent by electricity) was inside the balance-tube instead of outside it as before; and the pith-balls of the former apparatus were replaced by brass balls. By careful management, and turning the tube round, the author could place the equipoised brass pole either over, under, or at the side of the source of heat. With this apparatus it was intended to ascertain more about the behaviour of the balance during the progress of the exhaustion, both below and above the point of no action, and also to ascertain the pressure corresponding with this critical point.

After describing many experiments with the ball in various positions in respect to the incandescent spiral, and at different pressures, the general result appeared to be expressed by the statement that the tendency in each case was to bring the centre of gravity of the brass ball as near as possible to the source of heat, when air of ordinary density, or even highly rarefied, surrounded the balance. The author continues:—

"44. The pump was then worked until the gauge had risen to 5 millims. of the barometric height. On arranging the ball above the spiral (and making contact with the battery), the attraction was still strong, drawing the ball downwards a distance of 2 millims. The pump continuing to work, the gauge rose until it was within 1 millim. of the barometer. The attraction of the hot spiral for the ball was still evident, drawing it down when placed below it, and up when placed above it. The movement was, however, much less decided than before; and in spite of previous experience (33, 34) the inference was very strong that the attraction would gradually diminish until the vacuum was absolute, and that then, and not till then, the neutral point would be reached. Within one millimetre of a vacuum there appeared to be no room for a change of sign.

"45. The gauge rose until there was only half a millimetre between it and the barometer. The metallic hammering heard when the rarefaction is close upon a vacuum commenced, and the falling mercury only occasionally took down a bubble of air. On turning on the battery current, there was the faintest possible movement of the brass ball (towards the spiral) in the direction of attraction.

"46. The working of the pump was continued. On next making contact with the battery no movement could be detected. The red-hot spiral neither attracted nor repelled; I had arrived at the critical point. On looking at the gauge I saw it was level with the barometer.

"47. The pump was now kept at full work for an hour. The gauge did not rise perceptibly, but the metallic hammer increased in sharpness, and I could see that a bubble or two of air had been carried down. On igniting the spiral, I saw that the critical point had been passed. The sign had changed, and the action was faint but unmistakable repulsion. The pump was still kept going, and an obser-

vation was taken from time to time during several hours. The repulsion continued to increase. The tubes of the pump were now washed out with oil of vitriol,* and the working was continued for an hour.

"48. The action of the incandescent spiral was now found to be energetically *repellent*, whether it was placed above or below the brass ball. The fingers exerted a repellent action, as did also a warm glass rod, a spirit-flame, and a piece of hot copper."

In order to decide once for all whether these actions really were due to air-currents, a form of apparatus was fitted up, which, whilst it would settle the question indisputably, would at the same time be likely to afford information of much interest.

By chemical means a vacuum was obtained in an apparatus so nearly perfect that it would not carry a current from a Ruhmkorff's coil when connected with platinum wires sealed into the tube. In such a vacuum the repulsion by heat is decided and energetic.

An experiment is next described, in which the rays of the sun, and then the different portions of the solar spectrum, are projected into the delicately suspended pith-ball balance. *In vacuo* the repulsion is so strong as to cause danger to the apparatus, and resembles that which would be produced by the physical impact of a material body.

Experiments are next described in which various substances are used as the gravitating masses. Amongst these are ivory, brass, pith, platinum, gilt pith, silver, bismuth, selenium, copper, mica, (horizontal and vertical), charcoal, &c.

The behaviour of a glass beam with glass ends in a chemical vacuum, and at lower exhaustion, is next accurately examined, when heat is applied in different ways.

On suspending the light index by means of a cocoon fibre in a long glass tube, furnished with a bulb at the end, and exhausting in various ways, the author finds that the attraction to a hot body in air, and the repulsion from a hot body *in vacuo*, are very apparent.

Speaking of Cavendish's celebrated experiment, the author says that he has experimented for some months on an apparatus of this kind, and gives the following outline of one of the results he has obtained:—

"A heavy metallic mass, when brought near a delicately suspended light ball, attracts or repels it under the following circumstances.

"I. When the ball is in air of ordinary density.

- a. If the mass is *colder* than the ball, it *repels* the ball.
- b. If the mass is *hotter* than the ball, it *attracts* the ball.

"II. When the ball is in a vacuum.

- a. If the mass is *colder* than the ball, it *attracts* the ball.
- b. If the mass is *hotter* than the ball, it *repels* the ball."

The author continues:—"The density of the medium surrounding the ball, the material of which the ball is made, and a very slight difference between the temperatures of the mass and the ball, exert so strong an influence over the attractive and repulsive force, and it has been so difficult for me to eliminate all interfering actions of temperature, electricity, &c., that I have not yet been able to get distinct evidence of an independent force (not being of the nature of heat) urging the ball and the mass together.

"Experiment has, however, showed me that, whilst the action is in one direction in dense air, and in the opposite direction in a vacuum, there is an intermediate pressure at which differences of temperature appear to exert little or no interfering action. By experimenting at this

* This can be effected without interfering with the exhaustion.

critical pressure, it would seem that such an action as was obtained by Cavendish, Reich, and Baily, should be rendered evident."

After discussing the explanations which may be given of these actions, and showing that they cannot be due to air-currents, the author refers to evidences of this repulsive action of heat, and attractive action of cold, in Nature. In that portion of the sun's radiation which is called heat, we have the radial repulsive force possessing successive propagation required to explain the phenomena of comets and the shape and changes of the nebulae. To compare small things with great (to argue from pieces of straw up to heavenly bodies), it is not improbable that the attraction now shown to exist between a cold and a warm body will equally prevail when, for the temperature of melting ice is substituted the cold of space, for a pith ball a celestial sphere, and for an artificial vacuum a stellar void. In the radiant molecular energy of cosmical masses may at last be found that "agent acting constantly according to certain laws," which Newton held to be the cause of gravity.

CHEMICAL REAGENTS.

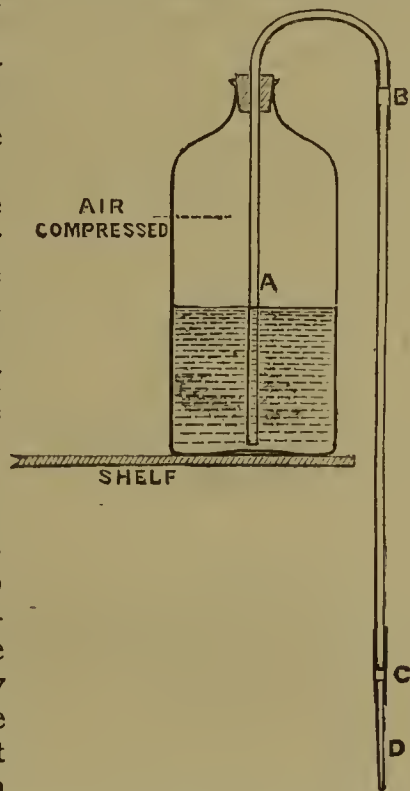
By R. H. RIDOUT.

IN chemical analysis, where small quantities of the reagent are wanted frequently, much time is lost in taking the stoppers out of the bottles, and then, no matter what care may be exercised, there is always a small quantity of the reagent left to evaporate on the rim of the neck of the bottle, and many reagents which are deteriorated by exposure to the air have to be prepared only in small quantities. To obviate these petty annoyances, I have adopted the following plan with the best results:—

The bottles to contain the reagents are about two or more times the size of the bottles in which they are ordinarily contained. A is a bottle having a glass tube passing through a first-rate cork in the narrow neck. The end of the tube in the bottle is within about $\frac{1}{2}$ inch of the bottom; the other end makes a complete arch, and is connected to the glass tube, BC, by an india-rubber junction. D is a fine glass jet, fixed also to BC by an india-rubber junction, the ends of the tubes being just far enough apart to allow a pinch-cock to be placed on the india-rubber tube. The reagent is placed in a wash-bottle, its jet being connected to the jet B by an india-rubber tube. A bladder is attached to the mouth-piece, and the liquid forced up CB into the bottle, thereby compressing that air in the bottle above the reagent. The pinch-cock being put up in c, the reagent is prevented escaping. When the pinch-cock is opened, the air on the surface of the liquid A will force it through the tubes and out of the jet D drop by drop, or in a rapid stream, as may be desired.

It will be seen that the liquid never comes into contact with any air except that in the bottle, and this may either be purified from harmful compounds, or another gas substituted having no action upon the liquid.

The india-rubber junction prevents its application to strong acids, but by far the greater number of reagents are unaffected by one form or another.



FOOD ANALYSIS:

I. NOTE ON THE ESTIMATION OF FAT IN MILK.

By J. ALFRED WANKLYN.

It is well known that some difficulty has been experienced in making a complete extraction of the fat which exists in milk. This difficulty appears to arise partly from the presence of water, which appears to protect the fat from the action of the ether; and, in order to effect a complete extraction, it appears to be necessary first to get rid of the water of the milk by evaporation, and then to boil the dry residue repeatedly with ether.

Since the publication of my recent "Manual of Milk-Analysis, I have adopted a very convenient form of apparatus for carrying out these and analogous extractions; and, although the device is apparently trifling, it may possibly be of service to describe it at the present time.

The operations are first of all the drying up of a small quantity of milk, and afterwards the boiling of the residue with ether; and a vessel, which is alternately an evaporating basin and a flask, is exactly that which is called for.

These conditions are fulfilled as follows:—A thin platinum dish, capable of holding about 50 c.c. is employed, and in it the portion of milk (5 or 10 c.c. accurately measured), is evaporated to dryness. The dish, during this evaporation, is heated in the water-bath, which consists simply of a beaker half-filled with water which is boiled over the lamp. The milk, as it is being evaporated, may be stirred up with a small glass rod, or small platinum spatula. The milk-residue having been obtained in a state of tolerable dryness, it is covered with 20 or 30 c.c. of ether, and a *small inverted funnel* is fitted moderately tightly into the platinum dish, which is thereby converted into a flask. The further details are obvious.

By the adoption of this apparatus, the determination of the fat in milk becomes perfectly easy.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Concluded from page 392).

THE amount of steam converted into visible vapour, and cause of excessive loss of power in ordinary steam-engines may be made clear in this way. There is in the receiver of the air-pump a piece of sponge with a little water on it; if a portion of the air saturated with vapour be pumped out, a small portion of the water is converted into vapour, which you see deposited in a film on the glass. This is caused by the air being rarefied, and becoming colder, therefore not competent to hold in solution as much vapour as it had previously done. Now, what takes place in this receiver is taking place in hundreds of steam-engine cylinders, and wasting pounds and pounds of fuel. As soon as the steam enters the cylinder it fills it, or rather it fills the part of the cylinder below the piston. Arrangements are usually made that a portion of the stroke may be accomplished by the expansive action of the steam. Now, as soon as the opportunity for expansion is presented, there is at once this deposit of moisture, and the deposit is indicative of a sacrifice of heat.

Now, this action of heat is not confined to liquids, it also extends to solids. Here is a piece of unannealed glass. Those present who have to deal with steam-engines, know that it very often happens from some apparently unaccountable cause, that what are called the

* The Cantor Lectures, delivered before the Society of Arts.

water-gauges of the boilers are broken. These breakages are in consequence of the glass tubes being unannealed; and if you are aware of the process by which tubes are made, you will see at once they cannot, without some special arrangements, be annealed. They are made by taking a solid ball of glass out of the pot; this is then blown into a globe; then a second man puts a pipe with a molten nodule of glass upon it on that part of the globe which is opposite to the pipe by which it was blown. The men run asunder, and so the globe is lengthened out into a tube and laid along the floor. This long pipe is then cut into gauge-tube lengths, and generally so sold. If one of these tubes be cleaned with an iron wire, having a piece of cotton-wool wrapped round it, the wire being pushed up and down as is usually done, and the clean tube be restored to the boiler, it may, in two or three days or weeks, fall to pieces without any one being to blame, except those who put the wire through the tube. Here is a piece of glass very thick and strong, and in all respects very good glass, but unannealed. It is really a simple piece taken out of the melting-pot as a sample, to guide the manufacturer respecting the quality and colour of the articles that may be made from it. Now, in all probability, if this piece of quartz, less than the size of an ordinary pea, be allowed to drop gently into the sample flask, this strong flask (the glass is nearly one-half of an inch in thickness) may fall into pieces. There! You see the bottom has immediately dropped out, notwithstanding the thickness, and if it were left here all night it might crumble into half-a-dozen pieces before the morning. On one occasion I cleaned out a glass tube, about three feet long, connected with an air-pump, and in a thoughtless moment took a wire, attached some cotton-wool to it, and drew it through the tube. In about half an hour there was a slight click—in a few minutes another click. On looking at the tube it was seen to be cracked. The slight but instructive noises continued, click after click, and crack after crack, and in the morning the tube was separated into many hundred pieces, though no one touched it. Workmen and servants are often blamed for the breakage of glass, which breakage arises from such a cause as this.

What are called Prince Rupert's drops are obtained by allowing molten glass to fall into water, and so falling, the drops are suddenly cooled on the outside, and the consequence is that the molten glass in the interior is firmly bound beyond its power of resistance, even though it has a large amount of heat in it. If it had been free, the molecules of glass would have crystallised, and arranged themselves according to the law which governs them; but being bound by the external film they cannot so arrange themselves. The heat contained in them cannot do the works of crystallisation it was competent to do—it has become stored up or potential. Therefore, as soon as ever the equilibrium of the shell of the bulb is destroyed this heat gives out its work. In the interior of this bulb there is a large amount of potential energy; and if the equilibrium be destroyed by cracking off the end, in the same way as it was destroyed in the other case by dropping a little bit of quartz into the thick glass, we shall find it will manifest itself, and very possibly will break the glass bottle in which the Rupert's drop is placed.

We will now pass on to a series of experiments, the object of which is to show the effect of heat in relation to solids and liquids, and converting them into vapour. Mr. Wills, to whom we were indebted for assistance on the evening of the lecture on the energy of affinity, has kindly undertaken to exhibit some striking and instructive experiments. In this iron bottle there is condensed carbonic acid gas, which under ordinary circumstances is a gas, but when it is brought under a pressure of 700 lbs. to the square inch it becomes a liquid. To re-convert it from liquid into gas requires a large amount of heat. The consequence is, one part takes heat from the other, whilst a portion of it is sent forward in the

form of vapour at the expense of the heat of the remainder. That remainder, therefore, becomes colder and colder, and appears in the form of ice and snow, as you see on turning the tap, and letting it escape into the room. The white substance which now is falling in the room is carbonic acid snow. There is an apparatus for enabling the vapour to pass round and round in a copper vessel, and then escape at the handles; in so doing it absorbs a large quantity of heat, and therefore that which remains in the vessel freezes. We shall collect in this way a large amount of snow, which can afterwards be used for other purposes. Nearly a pound weight of this carbonic snow is now deposited in the copper vessel, and so cold is it, that, on wrapping a piece of wet flannel round the vessel, it freezes immediately. This snow can be held lightly in the hand without inconvenience, but if pressed a blister will at once be raised. Mr. Wills has taken a small portion upon his tongue, and breathing out the vapour as it melts, a candle is immediately extinguished. In the same way some of it may be put in a beaker, and the gas collected as the snow melts, when it will be found that a light cannot live in it. Again, here is a bottle of water; by putting some carbonic snow into it, and corking it up, we immediately get excellent soda-water. By pouring some ether upon it, the degree of cold is greatly increased by the rapid evaporation, so that the vessel becomes frozen to the stool upon which it stands, and a pound or two of mercury will soon be frozen into a solid body. The temperature is about 130° below the freezing-point. On placing the frozen mercury at the top of a tall jar of water, beautiful icicles are immediately formed in consequence of the intense cold.

Before closing, attention may be directed to the sources whence our supplies of heat are derived. The classification of these, and the character of the heat derived from them, may be studied in the tabular form.

Sources.

A	..	..	..	..	Inherent Affinities.
B	..	..	..	..	Solar Radiation.
C	..	..	..	..	Earth's Rotation.
D	..	..	..	..	Earth's Internal Heat.

Stores.

Potential.	Whence Derived.
Fuel	B and A.
Food	B.
Reservoir Water	B.
Tidal Water	C.

Kinetic.	Whence Derived.
Winds	B.
Ocean Currents	B.
Hot Springs	D.
Volcanoes	D.

There is one other matter to which the subject of last week's lecture bears a very extraordinary relation. Science investigations have established that a process of what is called dissipation of energy is going on. In the lecture on the energy of light, attention was directed to a remarkable testimony which, through modern science views, is thus given to Scripture. Let me add a few words on an equally remarkable one in reference to the energy of heat. In the case of light, page 699, reference was made to the beginning of the Bible; in this case of heat it is to the end of it. St. John (Rev., vii., 16), speaking of the new heavens, writes, "Neither shall the sun light on them nor any heat." How singularly in accord with this is the declaration (Rev., xxi., 1), "There shall be no more sea, neither shall they thirst any more." Clearly, if the heat be not, there can be no water nor sea. Now, science testifies to the dissipation of heat, and thus unconsciously testifies to a gradual progress to that state which prophecy so plainly declares.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 18th, 1873.

E. W. BINNEY, F.R.S., F.G.S., Vice-President, in the Chair.

Mr. Arthur William Waters, F.G.S., Professor Arthur Gamgee, F.R.S., and Mr. Arthur Schuster, Ph.D., were elected Ordinary Members of the Society.

"On the Bursting of Trees and Objects struck by Lightning," by Professor OSBORNE REYNOLDS, M.A. In a paper on this subject read at the last meeting of this society I stated that the tube which was burst by a discharge from a jar would probably withstand an internal pressure of from 2 to 5 tons on the square inch; and I made use of the expression the tube might be fired like a gun without bursting. These statements were based on the calculated strength of the tube, and with a view to show that there was no mistake, I have since tried it in the following manner. I made three guns of the same tube. No. 1, which was 6 inches long, had its end stopped with a brass plug containing the fuze hole. Nos. 2 and 3 were 6 inches long and had their breeches drawn down so as only to leave a fuze hole. These tubes were loaded with gunpowder and shotted with slugs of wire which fitted them, and which were all $\frac{3}{4}$ inch long. No. 1 was first fired with $\frac{1}{2}$ inch of powder, the shot penetrated $\frac{1}{4}$ inch into a deal board, and the gun was uninjured. No. 2 was then fired with $1\frac{1}{2}$ inches of powder, and the shot went through the 1 inch deal board and $\frac{1}{2}$ inch into some mahogany behind, thus penetrating altogether $1\frac{1}{2}$ inches; the tube, however, was burst to fragments. Some of these were recovered, and although they were small they did not show cracks and signs of crushing like those from the electrical fracture. No. 3 was then fired with $\frac{3}{4}$ inch of powder, and the shot penetrated $\frac{1}{2}$ inch into the deal board. It was again fired with one inch of powder, and the shot penetrated 1 inch into the deal. Again it was a third time fired with $1\frac{1}{4}$ inches of powder, when it burst, and the shot only just dented the wood. These experiments seem to me to prove conclusively the great strength of the tube and the enormous bursting force of the electrical discharge.

"On the Colour of Nankin Cotton," by EDWARD SCHUNCK, Ph.D., F.R.S.—Among the numerous varieties of cotton existing in commerce there is one which cannot fail to strike the most unpractised eye, in consequence of the peculiar colour, varying from a pale yellow or rather fawn to a brown, or reddish-brown which it exhibits. This kind of cotton is generally called "Nankin" cotton in consequence of its having been used at an early period by the Chinese for the manufacture of the fabric called nankin or nankeen, the peculiar colour of which is so well known as to need no description. Specimens of raw cotton of the colour referred to from other countries, such as India, America, the West Coast of Africa, and the shores of the Mediterranean, are, however, found in all extensive collections, so that it cannot be considered as a product peculiar to China. In Malta it is, I am informed, especially abundant, more so than the ordinary white kind. Whether it is produced by a peculiar variety (not to say species) of the cotton plant, or whether the colour is owing to peculiarities of climate, soil, or method of culture influencing the plant, is, on the other hand, a question not easily determined. Considerable doubt indeed prevails as to the number of species embraced by the genus *Gossypium*, and the characters by which they are distinguished from one another, some authorities ad-

mitting only four species, whilst others describe more than twenty. Among the former is Dr. Forbes Royle, who says: "The result of our investigation of the species of the genus *Gossypium* is, that there are at least four distinct species which may be easily distinguished, and that the great mass, probably the whole of the cotton of commerce, is yielded by three of these species and their varieties." Attempts have been made to distinguish the various species of *Gossypium* according to the colour of the cotton produced by them, but, as might be anticipated, with little success, since the colour of the organs of plants seems to be one of the least persistent of their characteristics. Anyone, indeed, examining a collection of specimens of cotton fibre must see that there are few marked distinctions between them as regards colour, none being absolutely white, and the greater number exhibiting various shades of cream colour, verging to fawn. Nankin cotton may be considered as being placed, as far as colour is concerned, at the extreme end of the scale, at the other end of which we find Sea Island and other almost pure white kinds. Several authorities assert, it is true, that Nankin cotton is produced by one species of the genus only, viz., *G. religiosum*, but others say it is found on more than one species. Among the latter I may again quote Dr. Forbes Royle, who says: "*G. religiosum* of Linnaeus seems to be distinguished from other species only by having tawny-coloured cotton; but we have seen that both the common Indian cotton, the Chinese cotton, the arboreous species, and *G. barbadense* all occasionally produce nankeen-coloured cotton, and that, therefore, it cannot be considered as characteristic." Referring to "China cotton" the same author says†: "The specimen in *Herb. Hook.*, from Mr. Fortune, is less hairy than most Indian specimens, though clothed with a number of short hairs. Mr. Fortune states, in a note with some specimens that he sent to Dr. Lindley, from China, that the white-coloured and the nankeen-coloured cotton are yielded by the same species and even by the same plant, and that the two kinds are separated by the Chinese. Besides India and China, this species is cultivated in Persia, Syria, Asia Minor, and the Islands of the Mediterranean, as well as in the north of Africa, and the south of Europe. The kind yielding the nankeen-coloured cotton in Malta is probably a variety." Fortune in his Travels,‡ makes the following statement regarding the cotton plant of China: "The Chinese or Nanking cotton plant is the *Gossypium herbaceum* of botanists, and the '*Mie wha*' of the northern Chinese. It is a branching annual, growing from one to three or four feet in height, according to the richness of the soil, and flowering from August to October. . . . The yellow cotton, from which the beautiful Nanking cloth is manufactured, is called '*Tze mie wha*' by the Chinese, and differs but slightly in its structure and general appearance from the kind just noticed. I have often compared them in the cotton fields where they were growing, and although the yellow variety has a more stunted habit than the other, it has no characters which constitute a distinct species. It is merely an accidental variety, and although its seeds may generally produce the same kind, they doubtless frequently yield the white variety, and *vice versa*. Hence specimens of the yellow cotton are frequently found growing amongst the white in the immediate vicinity of Shanghai; and again a few miles northward, in the fields near the city of Poushan, on the banks of the Yang-tse-Kiang, where the yellow cotton abounds, I have often gathered specimens of the white variety." The opinion here expressed is confirmed by Parlatore, who affirms,|| without hesitation, that the plant bearing red or reddish cotton is merely a variety either of *G. arboreum* or *G. hirsutum*.

Mr. Thomas Clegg, of this city, who is familiar with

* "On the Culture and Commerce of Cotton, &c.," p. 151.

† *Ibid.*, p. 143.

‡ "Two Visits to the Tea Countries of China," vol. i., p. 199.

|| "Le Specie dei Cotonii." Firenze, 1866.

the properties of the various kinds of cotton, and well acquainted with their commercial value and places of growth, has kindly lent me some of his specimens for exhibition on this occasion, and in a communication received from him he has given me some information regarding Nankin cotton, which will, no doubt, be of interest to the meeting.

Mr. Clegg says: "I found Nankin cotton abundantly at Malta, many parts of Tunis, and in great quantities on the West Coast of Africa. Dr. Livingstone has sent me many samples of it, and I have frequently had specimens of it from other, but always arid, dry, and hot parts of the world. The Maltese has, however, always been the best. It is very short in staple, coarse, and of little value in itself, especially as so little of it is produced. Being high-coloured, of course if used alone it would give a high peculiar colour to the cloth, and as mixing it with whiter cotton generally stripes and spoils the cloth, it is in very bad repute. In China and Japan it gets more dusky and dark, and even lower in staple. On the West Coast of Africa it seems to be hybridised and modified in colour. The seed, when cleaned from the cotton, is generally only half-clothed with the fibre, the other half being black. But whether entirely Nankin-coloured or a little whiter, it is always on that coast much longer in staple, and, though rather coarse, still a good useful cotton. Indeed, the generality of the West Coast cotton is a nice cream-coloured cotton, a little higher than the old Demerara cotton used to be, and of staple on an average fully equal to American bowed upland, or the lower class of New Orleans, and I hardly think can be classed as Nankin at all, though high-coloured. If it could be had in quantity, it would, in my opinion, soon supersede all the lower qualities of American cotton. Nankin cotton is always, so far as I have seen, from fibrous-coated seed. As to colour, I cannot tell, being no chemist, whether it is fast or not, but it never seems to fade with me. . . . According to my experience, it is only in very hot countries, and on a rather arid soil, that the really dark Nankin is produced. I think if experiments were tried for three or four years together, Maltese on the West Coast of Africa would resemble African, and West African seed sown at Malta would become Maltese cotton; and I almost think that West African seed which at home produces yellow-tinged cotton, would, in one or two years, in the New Orleans district, produce white cotton. And I further think that pure New Orleans seed sown at Malta in three or four years would give cotton of the red tinge of ordinary Maltese." Mr. Clegg seems therefore to agree with those who think that the variations in colour observed in cotton are entirely owing to differences of climate and soil, and are not peculiarities attaching to different species of the plant.

These remarks will suffice to give a general idea of the properties of Nankin cotton and its supposed origin. I propose in this communication to give a short account of some experiments made to ascertain the cause of the peculiar colour by which it is characterised.

The colour of Nankin cloth having been successfully imitated in this country by depositing oxide of iron on and within the fibres in the manner well known to dyers, it might be supposed that the colour of the raw cotton was due to iron in some form. The simplest experiments prove this, however, not to be the case. The cotton on being incinerated leaves an ash which does not contain a larger proportion of iron than that of ordinary cotton, and the colour is not removed by treating the cotton with dilute mineral acids capable of dissolving oxide of iron, whereas the colouring matter dissolves, though slowly, on boiling it with caustic soda lye. Another mode of imitating the colour consists in mordanting the fabric with alum, and then dyeing with oak bark, the process resembling that by which calico is ordinarily dyed of a yellow or fawn colour. It is evident, however, from its resisting the action of acids, that the colour of Nankin cotton cannot be due to the presence of a lake of alumina

or any other base. In order to arrive at some conclusion regarding the nature of the colouring matter, it was necessary to employ large quantities of material, for though the colour looks intense when the cotton is viewed in mass, it is in reality produced by a small quantity of substance spread over a large extent of surface, in this respect resembling the colour of the petals of some flowers. I therefore had recourse to the plan adopted on a previous occasion, and described in a paper I had the honour of reading before this Society several years ago.* A quantity of yarn made entirely from Nankin cotton (from the coast of Coromandel) was submitted to the usual process of bleaching, and the dark brown liquid obtained by treating the yarn with boiling alkaline lye was mixed with an excess of acid, which produced a dark brown flocculent precipitate. This was filtered off, washed with water, and then treated exactly in the manner described in the paper just referred to. It was found to contain the same substances as the precipitate obtained in the same way from alkaline lyes with which ordinary Indian or American cotton had been treated, viz., cotton wax, fusing at the same temperature, and having the same general properties as that from ordinary cotton, a white crystalline fatty acid (probably margaric acid) pectic acid, parapectic acid, and, lastly, colouring matters. It is to the latter that the cotton owes its colour, for this colour is removed to a great extent by treatment with alkali, while the colouring matters are thrown down from the liquid on the addition of acid, and I therefore examined them with more care than the other constituents of the precipitate. These colouring matters I found to be at least two in number. One of them is easily soluble in alcohol, and is obtained, on evaporating the solution, as a dark brown, shining, transparent resin. The other is almost insoluble in cold alcohol, but dissolves in boiling alcohol, and is deposited, on the solution cooling, in the form of a light brown powder. Their properties are in general the same as those of the analogous colouring matters from ordinary cotton. They contain, like these, C, H, N, and O, but in somewhat different relative proportions. Their composition in 100 parts I found to be as follows:—

	A.	B.
	Colouring matter soluble in cold alcohol.	Colouring matter insoluble in cold alcohol.
C	58.22	57.70
H	5.42	5.60
N	3.73	4.99
O	32.63	31.71

The composition of the analogous colouring matters from American cotton, according to previous determinations, was as follows:—

	A.	B.
C	58.42	58.36
H	5.85	5.71
N	5.26	7.60
O	30.47	28.33

The difference in composition, in the first case at least, is not greater than may be expected with substances of the purity of which, in consequence of their not occurring in a crystallised state, one can never be perfectly sure. On the whole, I think these experiments justify the conclusion at which I have arrived, viz., that the colour of Nankin cotton is due to the presence of bodies which are very similar to, if not identical with, those which cause the much fainter tints of the ordinary kinds. They show, too, that the substances accompanying the cellulose (whether clothing the fibres, or contained in their interior) are the same with this variety of cotton as with all those previously examined.

* "Memoirs," 3rd Series, vol. iv., p. 95.

"An Improved Method for preparing Marsh-Gas," by C. SCHORLEMMER, F.R.S.

Everyone who ever had to prepare soda-lime knows that the preparation of this substance is a troublesome as well as a laborious process. Chemists will therefore hail with pleasure a paper "On the Determination of Nitrogen," by S. W. Johnson (*Liebig's Ann.*, 159, 69). He has found that in using the method of Varrentrapp and Will, soda-lime may be replaced by an intimate mixture, of about equal weights, of anhydrous sodium carbonate and dry slaked lime. It occurred to me that such a mixture might also be employed instead of soda-lime in the preparation of marsh-gas, and I found that by heating an intimate mixture of anhydrous sodium acetate with more than twice its weight of lime and sodium carbonate, a very regular and quiet evolution of marsh-gas took place. The gas thus obtained always contains some acetone, which is easily removed by shaking it with water, or, better still, with a solution of acid sodium sulphite.

GLASGOW PHILOSOPHICAL SOCIETY.
(CHEMICAL SECTION).

Ordinary Meeting, December 8th, 1873.

Mr. EDWARD C. C. STANFORD, F.C.S., President, in the Chair.

IN his inaugural address as President of the Chemical Section, Mr. Stanford said it was not his intention to review the progress of chemical science in this country during the past year; indeed, he was more disposed to call attention to what we ought to have done than to congratulate ourselves on what we have done. No one who studied that extremely valuable synopsis of original papers now published by the Chemical Society could fail to remark what a small proportion of that volume was devoted to the discoveries of British chemists. There was no doubt that original researches were becoming scarcer in this country. There were several reasons for this diminution. In the first place, we had lost a number of eminent men, who might be considered irreplaceable in this respect—Faraday, Miller, and a Glasgow citizen, Graham, were no longer with us. One of the most accomplished living chemists had entered our Government, and although the tardy recognition of the value of scientific knowledge at head-quarters had been appreciated, and although we might applaud the elevation of a man who would do honour to those who had elected him as a colleague, we nevertheless mourned the chemist lost.

We could scarcely speak of the eminent men we had lost without mentioning Liebig, whose name had been so long even a British "household word." For fifty years his prolific inventions had filled our scientific journals with original papers, involving most important discoveries. Although chemical books were not generally very readable works, he had the charm of writing his views so as to give the world instruction in the most attractive form, and perhaps no man had done so much to make chemical science popular. He (Mr. Stanford) hoped that Liebig's example would not be forgotten, and that his industry might stimulate all our young chemists. There was ample field for all; in fact, it might be said that the harvest was plenteous, but the labourers few. Chemical professors were now so engaged in the instruction of youth, in the detection of adulterations, and general analysis, that they have less time for original research. On each of these points Mr. Stanford proceeded to make a few remarks.

It had at last been admitted that the three R's did not entirely qualify a boy for society, and that even Latin and Greek, however well caned or birched into him, were not a perfect mental training. We had awakened at last to the belief that he ought to know something about the air

he breathes, the food he eats, and the fluids he drinks. Some sanguine individuals had thought that even the earth he lives on should not be in every sense beneath his notice. Physical science as a mental training must sooner or later be recognised. Even with very young boys there could be no more valuable study than qualitative analysis; he knew of nothing which so easily brought out the powers of observation and reasoning, and these powers would retain their influence on the mind long after the problems of Euclid had faded from the memory; Humboldt says: "To behold is not necessarily to observe, and the power of comparing and combining is only to be obtained by education. It is much to be regretted that habits of exact observation are not cultivated in our schools: to this deficiency may be traced much of the fallacious reasoning, the false philosophy, which prevails."

The late Dr. Guthrie, in his "Autobiography," did not lament the accident which made him substitute the study of physical science for that of mathematics. Faraday's discoveries showed that the former was much more useful practically than the latter, and the minds of these two men in their breadth, and their depth, and their fulness, showed the value of science teaching. We might look confidently for a large spread of this teaching in the present century.

The Adulteration Act would, when it was properly amended, and made universally compulsory, give increased employment to a large number of chemists, and even now the appointment of Medical Officers of Health in many places showed that the right men could not be got in sufficient number, or that the qualifications for the office were entirely misunderstood. Of all analysis there was nothing so difficult as the detection of adulterations; it required the very highest qualifications—not only the most consummate facility in ordinary analysis, but a large experience of trade, and a perfect knowledge of *Materia Medica*, and of the sources or manufacture of all our necessities.

Unfortunately, it had hitherto been mostly in the hands of microscopists; but now, when we were to punish the delinquents, we must have exact chemical quantitative evidence. In many cases the methods to attain this had yet to be discovered.

Then came the question of "What is adulteration?" and this, apparently, was not easily answered. Take, for instance, that ridiculous prosecution in London, where a druggist was fined for selling a well-known effervescent saline under the name of "Citrate of Magnesia," when it contained none of that body, and was known not to contain it; how that could be an adulteration he could not imagine. The Pharmaceutical Society were taking action in this instance, and it was to be hoped that the Pharmacy Act would prevent the analysts having to wander over the whole range of *Materia Medica*, for which they would probably be extremely thankful. A vendor was recently charged, in Edinburgh, under this Act, with adulterating beer with acetic acid, by selling a beverage known as "Hard Ale." Could any misnomer be more absurd than to call this an adulteration? In many parts of England where ale was the general beverage, and where much was "home brewed," there was a decided preference for "Old Ale," or ale which had to a certain extent undergone acetic fermentation. The old "strong beer" of the South of England harvest suppers, the best the master could give, was quite tart from keeping. As well might a wine merchant be fined for selling "Old Port," as a publican for selling "Old Ale." Mr. Stanford mentioned these two instances only to show how easily ignorance might abuse power; and if it were true that "power showed the man," then he said that the prosecutors in these cases were incompetent. So many other cases of gross miscarriage of justice under the Act were now so notorious that some amendments must ere long be made.

The amount of general analysis required throughout

the country was very considerable; chemical manufacturers had ceased to be "rule-of-thumb" men; they bought and sold by analysis, and a most important element in every large chemical works was the staff of chemists and the laboratory. Even farmers must now have their manures bought by analysis; they had actually found out the value of analytical fees. This field for work must yet largely increase. With the late president, Dr. Wallace, he quite agreed, that these commercial analyses had attained a remarkable degree of scientific precision; indeed, he would go further, and, speaking from experience, assert that, thanks to him and the other analytical chemists in Glasgow, he knew of no large manufacturing centre where greater accuracy could be relied on. But they still required some more perfect universal standards of accuracy, and they ought to attain to some general methods which should make the differences among chemists impossible, or at any rate reduce it to a minimum. Unfortunately, manufacturers knew that there still existed the scandal to the profession of "high and low chemists," and that it paid best to sell by one and buy by the other. It was painful to reflect that scarcely two analysts would agree on the strength of a superphosphate, and still more painful, in an accurate science like chemistry, to notice how large the difference might be, even amongst the most eminent men. Again, look at the great difference of opinion as to the estimation of what was called previous sewage contamination in water, a subject the growing importance of which demanded from all chemists the most perfect concord. Again, take the statement of analyses, for instance, the arrangement of the acids in tabulating an analysis of a potash salt containing soda; chemists differed widely as to that, and it leads to great confusion. Then, in stating superphosphate analyses, was precipitated or reduced phosphate to be valued? and if so, as he believed it certainly ought to be, what was to be the solvent employed? Numerous other instances would occur to the members of the necessity of real standards; and he pressed the importance of the question on the meeting; indeed, he hoped to bring it before them again, because he hoped it would lead to some action being taken on the subject. The Chemical Society would not enter into such investigations, but it might be possible to obtain a committee appointed by the British Association, to inquire into the most pressing of these questions. There was now a precedent for this; for at the Brighton Meeting last year Mr. W. Chandler Roberts, Chemist to the Mint, through the Committee of the Chemical Section, got a committee appointed to inquire into the best method of making gold assays; this committee was still engaged in the work, but the first report was published. Now, there was nothing in analysis so accurate as gold assaying; these assays were correct to the 10,000th part of the alloy used, and yet, according to the Report, five independent assayers gave in assays of the same gold ingots, having the average difference of 6-10,000th parts. As the quantity coined last year was £15,200,000, an error of only 1-10,1000th part would make a difference of £1500. If such accuracy as this required a committee of revision, surely they might ask for the same for the comparatively crude methods on which chemists bought and sold, and the differences in the analysis of which (often 2 or 3 per cent) involved the loss, or the wrongful gain, of large sums of money. He would not attempt to estimate the enormous sums thus annually in dispute from differences in analysis, but they would at once perceive that, considering the enormous value of our chemical manufactures, it must be very considerable, and, he would add, it ought to be remediable.

The endowment of scientific research, so eloquently referred to by Prof. Williamson, and the late president of this Section, must become the policy of an enlightened and educational government; but here again there was nothing that required such good teachers, however diligent might be the pupils. A full and thorough knowledge of all that was known was absolutely necessary as a firm basis on

which to build any new investigations, and Gmelin's "Handbook" alone was an extensive work to master. Moreover, the highest talent was required in the teacher if he would so instruct the pupil as to prevent him wasting his time over new methods which could not reasonably offer any chance of success; and point out the avenues which he should follow to gain the end in view. A talented friend of Mr. Stanford's, now deceased, used to say, that no better investment of mercantile capital could be made than to buy up the services of an accomplished investigator, as, for instance, Faraday (if such a noble mind could be bought), and sell his discoveries. That was putting the matter on a commercial footing, but it was exactly the policy that the Government ought to see. And little would be done until they could be made to believe that the encouragement of scientific research must be a really good investment for the country. Time and money were quite as much required as talent, and they should be freely offered to those who were willing to devote their lives to hewing out the precious truths of science. But this is a practical age; and if the Government could be convinced that, while they spent such enormous sums on the cinchonas in India, the discovery of artificial quinine at home was not impossible, it might give them an interest in chemical research which would astonish themselves and chemists also. The French Government apparently did not think this impossible, and who should say what might be the result of a long and systematic and united investigation of several accomplished chemists backed by ample means in this direction? Alizarin and indigo had yielded to our search after truth; and there was little doubt that the alkaloids were a question of time and labour. Again the utilisation of waste offered a large field for investigation of a most profitable character; many substances which demanded considerable expenditure to merely get rid of, had now become a source of considerable profit. There was much still to do in this direction, and it was one in which the investigator might feel that he was doing the greatest good to his country. Seeing the advances made of late years no one could say that the chemical manufacturers of this country were not fully alive to the importance of the subject. And although original research was not very active there was some satisfaction to know that the Patent Office was as busy as ever. It might be that that was the only place to look for reward, but it spoke well for the talent of chemical manufacturers, that of late years some of the best original researches had been made by them,—during all the cares and anxieties which were inseparable from the management of a safe chemical works.

In conclusion Mr. Stanford made the following remarks:—And now having had a good deal to do with the origin of this Section, I wish to remind you of the real objects we have always had in view. We are very glad to receive such valuable complete papers as have since our commencement been read here, but we wish particularly to encourage short communications of investigations in progress, we do not mind how unfinished. We would be pleased to have any notes of laboratory phenomena brought before us for discussion; any little variations which would be considered beneath the notice of all but true philosophers, who have been called the observers of minute differences; any improvement of any process, however slight. In fact, if only some of you would give us short papers descriptive simply of failures, I do not hesitate to say it would be immensely instructive. Any investigator who knows a great number of methods that would answer is close on the track of one that will. What we want particularly here is food for discussion, and I would impress on our younger members that they should unhesitatingly supply this, as occasions arise and opportunities permit. It is always an advantage to a young investigator to get the opinions of others who are qualified to give them during the progress of a research. That timely sympathy and encouragement, often so valuable, will, I can promise, be always met with here.

CORRESPONDENCE.

"MANUAL OF PUBLIC HEALTH."

To the Editor of the Chemical News.

SIR,—I shall esteem it a great favour if you will allow me to publish in your columns that my authorship is confined, in this book, to Part III.—page 303 to page 374 inclusive,—and that I am not responsible for any other portion of the book.—I am, &c.,

J. ALFRED WANKLYN.

December 26, 1873.

A PROBLEM.

To the Editor of the Chemical News.

SIR,—The proposal of "Arsenious" as a "Christmas Puzzle for Chemists" has suggested the following problem for the exercise of ingenuity.

Given, a liquid (free from organic matter) containing all the common heavy metals, to separate them *one* at a time—not in groups. The metals present to be (Aq.), Hg, Pb, Bi, Cu, Cd, Sn, Sb, As, Fe, Al, Cr, Co, or Wi (not both), Zn and Mn.

I believe I have a solution of the problem, but am not sure that the process would "work." Of course a very perfect separation is not expected.—I am, &c.,

ANALYSIS.

ANALYST WORK IN NOVA SCOTIA.

To the Editor of the Chemical News.

SIR,—I see by late English papers that a man has been fined £10 for selling as citrate of magnesia a substance containing not a single grain of magnesia. This reminded me that about two years ago I examined some "citrate of magnesia" bought here, but whether imported from the States or the old country I do not know, and found it to consist of *sodium carbonate* and *tartaric acid*; the same results were got by some students in my laboratory the other day, on a sample bought here a short time since; so I suspect there is very little citrate of magnesia offered to the public.

Another instance of the use of new nomenclature came before me recently. An excellent "potash," made in the States, is sold here in tins, under such names as "snowflake potash," and the like. I procured a 1 lb. tin for twenty-five cents, and proceeded to make potassium chloride for use of students in testing. To my surprise the tests could not be made to answer. Presently it occurred to me that possibly the "potash" was *soda*, and this proved to be the case. It is, as I said, excellent, some grey and pinkish, some beautifully white; what I have contains no alumina, or only such traces as do not affect its value as an ordinary reagent. It might be supposed that the fact of its not deliquescing would be sufficient to show that it is not potash, but I have real potash brought from home nearly twenty years ago which remains perfectly dry in appearance, though the bottle has often been opened. Our atmosphere being not nearly as damp as that of England during the greater part of the year, and when I have been using the alkali, is no doubt the cause of this phenomenon which has often struck me as a curious proof of the dissimilarity of climates. The "potash" is made I suppose from cryolite.

That public analysts might occasionally find something to do on this side is evident from another fact or two I may mention. A physician once put into my hands here a little stick of "lunar caustic" he had got from the States; it was nicely wrapped in white paper and looked all right, but it was only *nitre*. Another physician had a receipt handed him by his partner in their drug-store, who was puzzled at some of the ingredients—*extractum Blodgetti* and *alanine* were some of

these. The doctor said he had never heard of such things; however, the *reverend* inventor of the "Medicine for Consumption," to be compounded according to the receipt, was ready to furnish them for some dollars on *written* application at his office in New York—he could, somehow, never be *seen* there. A packet was got, and given to me for analysis. It was found to contain little but corn-starch, with a small amount of cochineal and Rochelle salt. The price for about 2 ozs. was five dollars I was told. I found that "alanine" was an old name for meconine, which I do not think the reverend inventor had much of, unless he had communicated with Professor Anderson, of Glasgow.—I am, &c.

HENRY HOW.

King's College, Windsor, N.S.,
Dec. 15, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, November 17, 1873.

Second Memoir on the Mode of Intervention of Water in Chemical Action, and on the Relations Existing between Electromotor Force and Affinity.—M. Becquerel.—The following conclusions are drawn:—
1. The mixture of two neutral saline solutions, giving rise to a double decomposition with or without precipitate, produces an unbroken series of hydrates, acids, and alkalies, by the mediation of which double decompositions are effected, which do not disturb the equilibrium of the electric forces. 2. In the reaction of acid solutions with alkaline solutions, there are equally-produced hydrates, by the mediation of which the combination of acids and alkalies is effected, as may be recognised by the production of electromotor forces; but, in this case, there is an excess of electromotor force, arising from the direct reaction of the acid and the alkali. 3. The determination of the electromotor force serves not merely to compare the respective intensities of the affinities, but, further, to follow step by step their variations according as the solutions are more or less diluted with water. 4. In the mutual reaction of an acid and an alkaline solution, containing the same number of equivalents of water, the electromotor force is in an almost constant relation with that arising from a couple whose solutions contain an equivalent of water more than the foregoing. Thus, the ratio of the electromotor force of the couple $\text{SO}_3, 4\text{HO}$ and $\text{KO}, 4\text{HO}$ to that of the couple $\text{SO}_3, 5\text{HO}$ is equal to that of the couple $\text{SO}_3, 5\text{HO}$ and $\text{KO}, 5\text{HO}$ to $\text{SO}_3, 6\text{HO}$ and $\text{KO}, 6\text{HO}$. The relation then diminishes very slowly. This law appears to be general. We may, then, by means of a very simple empirical formula, find the electromotor force of any couple of the series which stands in a fixed relation to the affinity producing such force.

Action of Pure Water upon Certain Metals.—M. Chevreul.—The author points out that Guyton de Morveau long ago observed the action of pure water upon lead and zinc. M. Chevreul, being engaged in examining, in 1841, certain procedures for purifying water on ship-board, discovered copper in distilled water, deriving from a condenser made of that metal. In 1837, he pointed out the necessity of keeping all alkaline reagents in bottles free from lead, and urged the importance of always making "blank" experiments in toxicological cases to obviate the possibility of errors due to impure reagents.

New Process of Brewing Beer Unalterable on Keeping.—L. Pasteur.—This process has been already noticed.

Action of the Waters of the Seine and the Ourcq upon Lead.—M. Fordos.

Rotatory Power of the Hyposulphites.—M. E. Bichat.

Rotatory Power of Mannite.—M. Vignon.—These three papers have been already noticed.

Reply to Remarks by M. Tarry on the Theory of Solar Spots.—M. Faye.—M. Tarry argues that in the solar cyclones the current is ascending, not descending, from the analogy of our terrestrial cyclones, in which there is an afflux of air at the lower part towards the centre (not an escape). M. Faye's position is that the solar cyclones are clearly shown to be descending, and that our cyclones are probably not different. The turning movements of the photosphere extend downwards conically and indefinitely into the gaseous mass. Our waterspouts are mainly similar; also our tornados and cyclones, but less so. On our globe, the influence of the ground limits the natural development of the turning movements: the cyclones, *e.g.*, are truncated cones. Meteorologists are divided as to the aspirant force of cyclones; but, taking into account the limiting influence of the ground, M. Faye shows (from a sketch) that the (air) supply, and consequent *vis viva* of a waterspout, should, on M. Tarry's theory, diminish as the extremity approaches the ground (or water), becoming *nil* on contact, all communication with the lower air being then broken. But it is precisely then its mechanical effects are most violent. Hence the cause is from above, not from below—these vertical movements are descending, not ascending. A second objection raised by M. Tarry is that in our cyclones, if they resemble the solar spots, as conceived by M. Faye, we should find the air escaping from the centre, instead of moving towards it. M. Faye urges the limiting influence of the ground above referred to. The phenomena of waterspouts are freely developed on a large vertical scale; those of cyclones are checked at their outset. The cyclones are like vast waterspouts reduced to their mouth. If we could transport ourselves to the upper currents where the waterspouts commence, and where the orifice of their funnel is formed, we should there find the convergent movement of which M. Tarry speaks, and which is observed in cyclones. But we see waterspouts from below, and in air often calm, and where the original cause escapes us. On the other hand, the great movements of the atmosphere which give rise to cyclones involve at once the upper and the lower layers: we are at the very orifice of a funnel which cannot prolong itself through the ground; we are in the convergent movement which produces the cyclone—at the upper rudiment, in fact, of a gigantic *trombe*. Thus the word *trombe* would be more suitable for the spots, where the dynamical phenomenon is always complete and simple, than the word *cyclone*, which denotes a phenomenon hindered in its development by the surface of our globe. M. Faye has retained *cyclone*, as expressing more nearly the scale of the solar phenomena. The obstacle of the ground, while not affecting narrow gyratory movements, greatly influences larger ones, which are reduced, not merely to a turning disc, but to a simple ring, grazing the ground, and turning about a centre calm and free from clouds. The ring gradually dilates, and its velocity of gyration diminishes, till it ultimately disappears. The *trombes*, on the other hand (like the sun-spots), have no central calm space; if they dilate, it is not indefinitely; they differ from cyclones by gradually contracting; their vertical development is atrophied; and they seem to return to the clouds. Similarly, the spots are reduced to a pore, then to an invisible spot, and doubtless, they diminish as rapidly in depth. Waterspouts, American tornados, Chinese typhoons, and the great cyclones of 200 leagues diameter, are, then, all the same phenomenon, modified variously by the obstacle of the ground, which cuts the first at the point of their cone, the tornados much higher, and cyclones near their mouth, so as to reduce them to a turning ring. As to the fact of showers of sand and insects, urged by M. Tarry, M. Faye says he does not

pretend to determine, in all its details, the resistance-action of the ground, and he thinks the gyration of a vast ring is not incompatible with the raising of slightly inclined currents, which brush the ground and raise particles from it; but this does not warrant M. Tarry's inference. The author points out that that terrestrial meteorology may gain valuable information from study of analogous phenomena in the sun.

Death of M. Burdin.—M. Bertrand recalled the services rendered to science by this eminent engineer. It is to him we owe the first turbine.

Reply to Observations by M. Oudemans on the Influence of Atmospheric Refraction at the Instant of Contact in a Transit of Venus.—M. Dubois.—The author had, previously to M. Oudemans, shown that the refraction would not have a sensible influence.

Employment of the Prism in Verifying the Law of Double Refraction.—M. Stokes.—The author is led, by M. Abria's note, to call attention to a method he has described to the British Association and Royal Society, and which he thinks more easy, general, and exact than that of M. Abria.

On some Metallic Spectra.—M. Lecoq de Boisbaudran.—(1). *Lead*.—When the induction spark passes between two electrodes of lead, the spectrum consists merely of narrow lines; when the electrodes get covered with oxide of lead, there are the numerous characteristic bands, and some of the lines then disappear, while others retain their brightness. The action of the condenser is almost exactly opposite to that of oxidation; it intensifies the lines, and, where they are extinguished through oxidation, the condenser restores them. (2). *Chloride of Gold*.—In a gas-flame, this gives magnificent bands crossed by slightly nebulous lines, extending from yellow to blue-green. With the spark in a solution of AuCl_3 , the spectrum consists of green bands and a certain number of narrow lines, distributed between red and violet. The relative brightness of the lines varies according to the mode of operation. The author points out changes undergone by the lines $\epsilon 506.3$ and $\delta 523$ when one modifies the degree of dilution, the length of the spark, or the direction of the induced current. (3). *Thallium*.—The salts of thallium in a gas-flame give, besides the bright green line $\alpha 534.9$, another, faint and nebulous, having for wave-length 568.0. It seems to belong to thallium, for its relative intensity is maintained with various salts of thallium carefully purified. (4). *Lithium*.—From theoretical considerations, the author was led to expect the probable existence of a new line in the spectrum, having 413.0 for wave-length. He obtains merely a trace of this line on passing the induction spark in a solution of LiCl , but it can be easily had with the spark in Li_2OCO_2 at red heat. Two series of measurements gave 412.9 and 413 for the wave-length.

Maximum Density of Water; Mechanical Explanation of this Phenomenon.—M. de Mondesir.—The author supposes each molecule of water to consist of four elements or atoms, having the form of a sphere or ellipsoid of rotation with vertical axes. They are tangent to each other, and their centres are in the same horizontal plane. They turn about their axes, and it is this movement that represents the latent heat of water, and constitutes a dynamical work estimated, in heat-units, at about 80 calories per kilog. While the movements continue, the body remains liquid; it becomes solid when they cease. It is then that, according to the principle of transformation of work, the work due to the movement of rotation will be represented by the dynamical work due to the expansion of ice. He next explains how the movement of the four atoms may be stopped. He supposes the liquid divided into an infinite number of *molecular prisms*, formed by four planes tangent to the molecule. The four atoms, to turn harmoniously, must have only four points of contact with each other; with 5, rotation is impossible. The molecular orientation commences to change at 4° , so as to present five points of contact at zero [this is shown by figures].

Two diagonally opposite atoms approach each other, and the molecular prism comes to have a lozenge, instead of a square, for its base. It is then that ice is formed, in crystals with angles of 60° and 120° (which quite agrees with observation). Again, the volume of water must necessarily increase between 4° and zero. Water dilates, in general, under the influence of heat; and, so long as the temperature exceeds 4° , the molecular orientation remaining the same, the total or apparent volume will vary proportionally to the atomic volume. But the molecular orientation changing under 4° , the proportion ceases. M. de Mondesir then shows, by calculation and examination of his prisms, that, taking 0.00046 as the coefficient of expansion of water, the volumes of liquid water at zero and at 4° will be to each other as the numbers 1.00335 and 1.

Frigorific Effects Produced by Capillarity along with Evaporation.—(Continued).—M. Decharme.—When the jet of a pulveriser containing water is directed against a piece of porous paper dipping in sulphide of carbon, there is no formation of hoar-frost; but a jet of pulverised sulphide of carbon produces on the paper a circle of arborescences, increasing with the time. Directed to a thermometer-bulb, this jet will bring down the temperature from $+10^\circ$ to -22° . On a glass plate, the arborescences may be observed with a microscope. Among various porous substances submitted to the capillary action of sulphide of carbon, ordinary wood charcoal is of special interest; the sudden cooling produces contractions and crackings, often leading to rupture of the piece. The arrangement of the icy arborescences corresponds to the openings of the capillary vessels, terminal or lateral; they are in concentric crowns at the end, and arranged parallel on the lateral surface. The liquids capable of producing, like sulphide of carbon, arborescences in porous paper are (so far as known) chloroform, sulphuric ether, bromhydric ether; there are probably others among those whose boiling-point is under 60° . Sulphide of carbon gives the most rapid and intense effects, though its boiling-point (48°) is higher than that of sulphuric ether (35.5°), and the tension of its vapour (302 m.m. at 20°) is less than that of ether (433 m.m.). The frigorific effects on the thermometer-bulb wrapped in porous paper were nearly the same for all the liquids except chloroform, which diminishes the temperature less. The icy arborescences seem to be purely aqueous. Their point of fusion was exactly zero temperature, whatever liquid the phenomenon was got from; their taste and smell are *nil*. The water of fusion has the same density as that of pure water, and it gives the same velocity and capillary height in tubes and porous paper as water.

Quantity of Ammonia Contained in the Air at Different Altitudes.—M. Truchot.—The author finds that, while the proportion of CO_2 diminishes as you rise in the atmosphere—having been successively 0.632 m.g., 0.405 m.g., and 0.342 m.g. per litre at the three stations adopted, viz., Clermont Ferrand (395 m.), summit of Puy de Dôme (1446 m.), and summit of the Pic du Saucy (1884 m.),—the quantity of ammonia, on the contrary, increases—having been found at these stations, respectively, 1.12 m.g., 3.18 m.g., and 5.55 m.g. per cubic metre.

Remarks on MM. Pelouze and Audouin's Apparatus for Condensation of Liquefiable Matters in Gas.—M. Colladon.

Employment of Carrier Pigeons in Aërial Navigation.—M. de Fonvielle.—From Biot and Gay-Lussac's experiments it appeared that the pigeons did not return to their cot unless let off when the balloon was near the ground; otherwise, the rare air was insufficient for flight, and they fell with accelerated velocity. M. de Fonvielle attributes the failure of some recent American experiments to want of attention to this. But he thinks one might utilise pigeons at any height if they were perched on a parachute, to which they would probably adhere till it reached a layer of air dense enough to fly in. A pigeon once dispatched by Mr. Glaisher, at a height of 6437 metres,

when the balloon was rapidly descending, perched on the balloon till it judged the air *voluble*, and then set off to its cot. The author states that the *National* newspaper has a pigeon service for its last despatches from Versailles; it costs 30 francs daily. There are ten pigeons, which may carry five despatches the double voyage; the time of a voyage is fifteen to twenty minutes, according to the state of the atmosphere and direction of wind.

Reply to M. Faye as to the Solar Spots.—M. Reye.—The author insists on large ascending whirlwinds that have been observed on our globe. He calculates that, in a cyclone which occurred in Cuba in 1844, and had a diameter of 1440 kilometres, the quantity of air raised must have been at least 420,000,000 cubic metres, or 49 kilograms. per second. The enormous cylinder formed by the hurricane would be filled with fresh air in less than five hours and a half. Another phenomenon insisted on is the thick layer of dense clouds which always covers the cyclone and surrounding regions, giving torrents of rain.

Direction of Propagation of Electricity.—M. Neyreneuf.

Reply to M. Mercadier's Last Note on the Vibratory Movement of an Elastic Wire.—M. Valerius.—The writer compares the laws he had previously established with those given by M. Mercadier.

Mass of Meteoric Iron Discovered in Digging a Trench; Molecular Structure of Meteoric Iron; Solid Protochloride of Iron in Meteorites.—J. Lawrence Smith.—The mass was found by a farmer in the county of Howard, state of Indiana, and at 60 centims. depth. It is an irregular oblong oval, and weighs 4 kilograms. When the surface is polished and treated with nitric acid, it gives none of Widmannstaetten's figures; indeed, the piece belongs to that class of iron which is rich in nickel (the percentage of which was 12.29).

MISCELLANEOUS.

Varley Testimonial.—At a preliminary meeting of the Committee, held the 20th of November, Sir William Fothergill Cooke in the chair, it was resolved to recommend that a Memoir of the late Cornelius Varley, illustrated with a photographic portrait, should be prepared and issued under the superintendence of the Committee, and that a copy be presented to his family, in token of the high estimation in which he was held; and, further, that some memorial be erected to his memory at the place of his interment. That the foregoing resolution be communicated to the absent Members of the Committee, and to his friends generally, asking them for their approval and co-operation on the Committee, and that subscriptions for the above object be invited.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in apparatus employed in the manufacture of salt. Thomas Bright Wilson, Manchester. March 11, 1873.—No. 875. In my improved arrangement the heat necessary for evaporating the brine-water is obtained from the combustion of fuel in a separate furnace and chamber, from which chamber the heated products of combustion are forced by a steam jet under one or more evaporating pans containing brine; the heat is imparted to the brine, and the cooled gases are allowed to escape into the air by a short pipe regulated by a valve or damper.

Improved combinations of substances or materials to be used as a substitute for coal, for obtaining heat and light, and in the arrangement of the furnaces or fire-places connected therewith. Joseph Jones, practical chemist, Great Lever, Lancaster. March 12, 1873.—No. 891. This invention consists, first, in combining, in various proportions, inferior coal, coal refuse, coal base, with sulphur stones, small pieces of paving or other stones, iron stones, copper stones or other pyrites, mud, peat, or earth, the constituents of water and water, and also the constituents of air and air; and, secondly, in improved arrangements

of the furnaces to suit the requirements of combustion. In one proportion—

The coal base is	75 parts of a hundred.
Mud, earth, or peat.. .. .	10 " "
Broken stones	6 " "
Pyrites.. .. .	6 " "
Simple water or its constituents, or the excess in peat or earth	3 " "

100

These proportions are variable, but the main feature is to use the coal refuse and coal bases with one or more of these materials, so that when they are once ignited by wood or ordinary fuel the combustion of the gases give off intense heat and consume the several substances, the moist mud, earth, or peat, which are at present required to be dried. In order to adapt the furnaces or fire-places for the combustion of the before-mentioned substances, it is necessary that the admission of air or its constituents should be perfectly controlled or regulated, and therefore the door or front of the furnace or fire-place and ash-pit should be kept closed, there being only a certain number of holes for the entrance of the air or its constituents, and a damper in the flue or chimney to vary the draught of air, some of the holes being stopped up when required. The fire-bars should be loose, with their ends in front, and a lid provided to prevent unnecessary admission of air, and the ashes can be let down into the ash-pit by turning or agitating the ends of the fire-bars.

Improved means of and apparatus for filtering or separating water from earthy matters from which cements and similar bodies are made. Frederick Burnett Houghton, 40, Borough Road, Southwark, Surrey. March 12, 1873.—No. 902. This refers to several special forms of apparatus for facilitating the separation of water from cement and other similar slip or slurry, details of which are described in the Provisional Specification.

Improvements in apparatus for dealing with sewage and other refuse or waste, so as to lessen the pollution of rivers. Robert Stevenson Symington, telegraph engineer, Glasgow, Lanark, North Britain. March 13, 1873.—No. 912. This invention relates to improvements in apparatus for the better carrying out and extending of the system described or referred to in No. 2667 of 1868. In one modification a neat and slightly cast-iron structure is used, being of a rectangular form in plan, and also having a rectangular contour in elevation, but with an arched space beneath the middle part of it. This cast-iron structure is provided with two inlets at the top, one for the connection of a soil-pipe from a series of water-closets, and the other for the connection of a waste-pipe from a series of sinks or jawboxes, baths, wash-hand basins, or the like. There are a compartment for solid matters and two filtering compartments for the liquids, whilst beneath there are receptacles for ashes and for vegetable and animal refuse. Various modifications are indicated.

Improvements in apparatus for condensing the vapours of naphtha. Charles Moseley, india-rubber manufacturer, Ardwick, Manchester. March 13, 1873.—No. 916. This invention consists in certain improvements in or additions to the invention for which former Letters Patent were granted to me on the 30th day of May, 1872, No. 1637. My present invention consists in causing the vapour current, after leaving the condenser, to pass through a number of wire gauze partitions fixed at intervals in a tube or cistern, which is kept partially filled with liquid naphtha, so that contact is formed between the body of naphtha and the vapour.

NOTES AND QUERIES.

Iodate of Calcium.—Will any of your correspondents inform me where the iodate of calcium, described in CHEMICAL NEWS, vol. xxviii., p. 297, can be obtained?—CHELT.

Fuller's Earth.—(Reply to A. K. C.)—In reply to a query in CHEMICAL NEWS, vol. xxviii., p. 316, you will oblige us by stating that fuller's earth may be obtained from us, who are the patentees of the use of it for refining oils, &c.—LAMBE & STERRY.

Fluorescent Spectra.—(Reply to W. J. Grey.)—Many substances (as, for instance, sulphate of quinine, uranium glass, and some constituents of crude petroleum) have the power of reducing the wavelength of the ultra-violet rays so as to produce visible light; and the "fluorescent spectrum" is the spectrum of this light. See Roscoe, "Spectrum Analysis."—H. R. PROCTER.

Notes on the Utilisation of Sewage.—(From the "Report of the Main Drainage Committee for 1864," vol. 487).

3314. (To Mr. Mechi.) Have you perceived any effect upon the springs and brooks which has been caused by the escape of the liquid into them after passing through the earth?—Very frequently.

3315. (To Mr. Mechi.) Is the land of which you are speaking drained?—The land is all drained at various depths, and no matter what the depth is, whether it is five feet, three feet, or seven feet, (for I have drained at all those depths), almost invariably, when we irrigate, we find that a portion of the sewage comes through into the brooks.

3317. Is it a very good soil?—It is a very stiff tile earth; a very great deal of it is too strong to make bricks of.

3318. And do you still find that some of the sewage escapes?—I do, and that the water comes through frequently coloured by the sewage.

3428. (To the same.) Then the examination of Mr. Johnson continues—"All the really fruitful properties are taken up by the actual crop, and there is no additional value to the soil itself, unless you can be continually applying sewage to it; is that so?—Exactly."—I think that that is not the case, for the reason which I have stated; and I know by Professor Voelcker's experiments that an important portion of the soluble and valuable parts of the manure filter through the soil and run away; I do not know whether the Committee have before them

an analysis of that pure water that leaves Mr. Marriage's farm, because I am convinced in my own mind (and I should like to see an official testing of it) that, though that water is as pure in appearance as spring water, it contains a large amount of soluble, but invisible and valuable, material.

3468. (To Mr. Acland.) If the sewage, instead of being allowed to flow into the water and pollute it, was applied to the land, would it not be a great benefit, by reason of the greater supply of food that would be thereby produced?—Seven or eight years ago, when I wrote the essay to which your Lordship has referred, I suppose that was an universal opinion, but subsequent inquiries appear to have modified that; that is to say, that although generally speaking some portions of sewage are exceedingly valuable, yet, as will appear in many reports which I have, the opinion as to the high value of sewage, is exceedingly modified. That appears, for instance, in Professor Way's evidence in the first Report of the last Select Committee of the House of Commons of 1862, and also from Professor Voelcker's evidence; not that I would wish to give a chemical or an agricultural opinion upon that point. I merely speak from what I have read and what I have learnt. But I take it that the opinion as to the high value of sewage is considerably modified.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 5.—Medical, 8.

TUESDAY, 6.—Royal Institution, 3. Prof. Tyndall, D.C.L., LL.D., "On the Motion and Sensation of Sound."

— Zoological, 8.30.

— Anthropological 8.

WEDNESDAY, 7.—Geological, 8.

THURSDAY, 8.—Microscopical, 8.

— Royal Institution, 3. Prof. Tyndall, D.C.L., LL.D., "On the Motion and Sensation of Sound."

— Royal, 8.30.

— Royal Society Club, 6.

FRIDAY, 9.—Astronomical, 8.

— Quekett Club, 8.

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(Organic)	2 p.m.	Pharmacy 2 p.m.
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THE CHEMICAL NEWS.

VOL. XXIX. No. 737.

THE POWER OF ATOMS.—SPECULATIVE.

HAVING begun to write on atoms, I am tempted to add a few speculations, which I trust will not be found too far removed from legitimate outlooks of reason, or too much in the region of fancy. Incapable as I am of seeing what we can do without Dalton's atom, it has been impossible to avoid thinking on the condition of things which existed before it. It has also seemed to me, as to many, that the primitive elements could not be many in number, from no inherent impossibility, but simply because of the tendency in Nature to proceed from the simple to the complex, and in doing so never to forget the past or to neglect the future. I have amused myself, therefore, by trying to make elements, as I have also amused myself by making forces to control them. I begin with one element, and I prefer the mode which I believe Graham first suggested of giving diversity. First let us read his own words from the *Proceedings of the Royal Society*, vol. xii., p. 620:—"It is conceivable that the various kinds of matter now recognised as different elementary substances may possess one and the same ultimate or atomic molecule existing in different conditions of movement. The essential unity of matter is in harmony with the equal action of gravity on all bodies. In the condition of gas, matter is deprived of numerous and varying properties with which it appears invested when in the form of liquid or solid. The gas exhibits only a few grand or simple features. These, again, may all be dependent on atomic or molecular mobility. Let us imagine one kind of substance only to exist—ponderable matter, and, further, that matter is divisible into ultimate atoms, uniform in size and weight. We shall have one substance and a common atom. With the atom at rest, the uniformity of matter would be perfect. But the atom possesses always more or less motion, due, it must be assumed, to a primordial impulse. This motion gives rise to volume. The more rapid the movement, the greater the space occupied by the atom, somewhat as the orb of a planet widens with the degree of projectile velocity. Matter is thus made to differ only in being lighter or denser matter. The specific motion of an atom being inalienable, light matter is no longer convertible into heavy matter. In short, matter of different density forms different substances, different inconvertible elements as they have been considered. What has already been said is not meant to apply to the gaseous volumes which we have occasion to measure and practically deal with, but to a lower order of molecules or atoms. The combining atoms hitherto spoken of are, therefore, not the molecules of which the movement is sensibly affected by heat, with gaseous expansion as the result. The gaseous molecule must itself be viewed as composed of a group or system of the preceding, inferior atoms following as a unit—laws similar to those which regulate its constituent atoms. We have, indeed, carried one step backward, and applied to the lower order of atoms ideas suggested by the gaseous molecule." He afterwards says, "the motion may be assumed to reside either in separate atoms and molecules, or in a fluid medium caused to undulate. A special rate of vibration or pulsation originally imparted to a portion of the fluid medium, enlivens that portion of matter with an individual existence, and constitutes it a distinct substance or element."

This ingenious theory of Graham does not teach us how to form atoms, but we may fairly look to some earlier state of matter—something utterly "without form"—for a beginning. At present, I begin with an atom ready formed, and start from the assumption that motion is the primitive,

although not the only, cause of diversity in all the elementary bodies. We could imagine the different size or specific gravity to be decided by the different range of the motion, and other characters by the different quality of the motion. I should prefer the first, because we have then one matter and one motion, and the simplicity is at the utmost. Diversity I suppose to be obtained, first, by interruptions in the motion, and, secondly, by collocation of atoms. But I see no reason for limiting the range by anything like a vibratory movement; that is too complex. The motion may be at first free and uncontrolled, and the direction one and unchanging. We might suppose all the atoms moving in one direction, and we should then require some mode of bringing them together. For simplicity, I shall suppose that each moves in a direct line, but that the direction of each is not the same, leaving the cause of this. And now let us try, as many others have done before us, to begin a world out of these conditions.

It would be easy to say that these atoms would be attracted by each other, and so would soon rush together, but if we speak in that way we must put gravitation into the particles first, and that we have not done yet. Some one will say, Can you suppose matter to exist without gravitation? Yes, I can, and indeed my difficulty has always been to suppose it existing with gravitation, which is by no means an intellectual necessity, although a valuable property. We have only one exceedingly active atom to deal with; I say exceedingly, because it must have an irrepressible tendency (or desire) to act—one that cannot be destroyed, although its action may be controlled or put a stop to in some form. We can imagine a body like hydrogen, very active and little inclined to combine, being so broken in its spirits, to speak in metaphor, and compressed permanently, that it becomes, say, like oxygen, less disposed to move, but with more tendency to combine than before. It has given up one power for another. It has parted with activity and obtained strength and power to unite—power of attraction, power of affinity. We can still proceed, and, in our imagination, picture oxygen, or nitrogen, or any gas still more compressed—whether only mechanically or not need not now be asked,—so that it shall lose all power to move, and become a heavy metal—gold or platinum. To compensate for the mobility of its youth, it has now weight; it feels that it cannot go, but it has a longing to go: the tendency is irrepressible; it is the original force out of which all its properties grow. According to our ideas of the conservation of force, this is quite in order. The loss of an energy must show itself in some form, and I suppose the loss of the primitive stage of activity to be followed by the primitive stage of attraction, gravitation, exactly as the loss of the present stage of gaseous activity is followed by attraction, chemical.

With this in view, let these atoms interfere with the motion of each other, and something must arise out of this interruption. The first result may be heat, but heat is not a permanent stage of a body; it is the result of interrupted activity or of work done. The inalienable tendency—the eternal quality, if we may so call it—remains exactly as before, so far as strength is concerned; but, having no outlet as before, it can only *tend*; that is, it can vibrate probably, or in some way aspire—it can attract or repel. This first stage of activity being now interrupted permanently, an office must be had for the power which does not die, and this we find in gravitation. It is analogous to smaller acts that occur before us.

Gravitation now begins among these interrupted atoms, and it must be powerful and crushing. In the struggle of the chaotic crowd, the fates of particles would be various. Some would in the centre be obliged very early to give up the battle, and might soon lie down as gold or platinum, no longer caring for their neighbours, but as full of real life as ever, shown by their cosmic relations, their gravitating powers. We can have any amount of diversity in this respect up to hydrogen, which still retains much of its primitive activity, but little weight—some, perhaps, like the æther of space, traversing everywhere.

In this, we suppose that a certain degree of uncontrolled activity may exist without gravitation. What is the nature of the control? Is it merely mechanical pressure, or why does a substance come down from one high stage of activity to a low stage? How is the spring broken as one may say? We could imagine vibrations when motion is interrupted, and indeed we must; and we might even seek for stages, as in musical notes and the vibration of chords, but this mechanism does not so well suit our original supposition, although it is one that must some day be properly followed out. The original supposition would suit more a colligation of atoms; first two put together, then three, &c. This would make a complete series of bodies, and we should have the various forces of Nature given out according to the repression of these atomic activities. Doubling the atom might render the action slower, and thus we keep to Graham's diversity-of-speed theory pretty clearly.

(The power of making stages, instead of infinite gradations, is a great one, which we owe to Dalton. Whether it may ever be used to account for *species* is worth enquiring. At first one supposes that it is useless to look to atoms, because it would require so many to make the difference, for example, between a mammoth and an elephant. But germs are very small, and it may be that as a few atoms make a difference in organic molecules, so a few organic molecules, in a suitable position in a germ, may cause that to grow up a tiger which would otherwise have grown into a cat.)

But we must not be led too far from the object, which is to imagine a mode of obtaining gravitation, as well as diversity of atoms, with excessive motion. I need not attempt to proceed further, seeing that Grove's "Correlation of Forces" can be read. He begins with motion, and expounds with great beauty many laws, not including gravitation, however. I fear that my expositions cannot be so well proved, but it is sometimes pleasant to wander among the spheres, and to play with the mighty forces of Nature for a time. I do not remember that anyone has looked on attraction as a consequent of suspended motion, or attempted to look on gravitation as the result of diminished atomic action, producing in this way many so-called elements, but it is difficult to remember all one reads. I am also unable to recollect if anyone has separated sufficiently that activity, the suppression of which produces heat, from the eternal tendency to motion—the inherent life of the atom, and which may possibly exist as vibration within limited space in chemical compounds.

So far as I can see this matter, I say nothing opposed to any theory of heat and force now established, but, in traversing infinite space and time with abundant liberty, one is apt to take the wrong road; fortunately the way back is easy, since little depends on these visions. The illustration and prosecution of this idea may bring more solid truth, whilst attempting to prove the speculation that there is one original motion as well as one original matter.

ATOM.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

IN June, 1862, and in February, 1863, I had the honour to lay before the Royal Society communications on the subject of the then newly discovered metal, thallium. In these I gave an account of its occurrence, distribution, and the method of extraction from the ore, together with its physical characteristics and chemical properties; also I discussed the position of thallium among elementary bodies, and gave a series of analytical notes.

In the pages of the *Journal of the Chemical Society*, for April 1, 1864, I collated all the information then extant, both from my own researches and from those of others, introducing qualitative descriptions of an extended series of the salts of the metal. I propose in the present paper to lay before the Royal Society the details and results of experiments which have engrossed much of my spare time during the last eight years, and which consist of very laborious researches on the atomic weight of thallium. In these researches I owe much to the munificence of the Royal Society for having placed at my disposal a large sum from the Government Grant. Without this supplement to my own resources it would have been difficult for me to have carried out the investigation with such completeness.

Section I.—ON THE DETERMINATION OF ATOMIC WEIGHTS.

In determining accurately the atomic weight of a metal that stands so high in the scale as thallium, difficulties and sources of error which are comparatively small with elements of low atomic weight are magnified to serious proportions, and require more than ordinary care for their elimination. When so large a proportion of the compound under analysis or synthesis consists of the body itself whose atomic weight is the one unknown quantity, it is evident that the almost unavoidable errors occasioned by impurity in the materials employed, the losses incident to imperfect manipulation, or the inaccuracies arising during the weighing from the omission of the corrections required by temperature, pressure, &c., will all find their way into the number which is finally considered to represent the atomic weight of the metal.

Nearly fourteen years ago, on taking the chair of the Chemical Section of the British Association at Leeds, the late Sir John Herschel called attention to the necessity which there then was for the introduction of greater accuracy in the determination of atomic weights. Speaking of the numerical relations which appear to exist between certain groups of elements, he considered that all these speculations took for granted a principle with which chemists had allowed themselves to be far too easily satisfied, viz., that all the atomic numbers are multiples of that of hydrogen. "Not until these numbers," he continues, "are determined with a precision approaching that of the elements of the planetary orbits—a precision which can leave no possible question of a tenth or a hundredth of a per cent, and in the presence of which such errors as are at present regarded tolerable in the atomic numbers of even the best determined elements shall be considered utterly inadmissible—I think can this question be settled; and when such gigantic consequences—so entire a system of nature—are to be based on a principle, nothing short of such evidence ought, I think, to be held conclusive, however seductive the theory may appear. I do not think such precision unattainable; and I think I perceive a way in which it might be attained, but one that would involve an expenditure of time, labour, and money, such as no private individual could bestow on it." Before this remarkable sentence was written, Professor Stas had commenced his classical researches on the atomic weights; and in 1861 he gave to the world the results of ten years' experiments, which had been conducted with a care and perseverance never surpassed in the history of experimental investigation. These researches of Professor Stas, and others which he has since made public, constitute a standard of excellence which chemists who are engaged on the important task of the determination of atomic weights should strive to attain. They are, in my opinion, the most noteworthy chemical memoirs that have ever been written: not only have they determined in the most definite and unassailable manner atomic weights about which scarcely any two chemists have agreed since the time of Berzelius, but they have raised the standard of accuracy in all chemical laboratories, and have set an example which, if followed, cannot fail to

* A Paper read before the Royal Society June 20, 1872.

exert an important influence on the progress of chemical science.

It has been with these researches before me that I have endeavoured to determine in a manner which should approach them in accuracy the atomic weight of thallium.

In the determination of an atomic weight analysis is inferior to synthesis; and especially is this the case when the number sought is amongst the highest known. The method followed should be one in which as few chemical elements as possible are employed, so as to reduce to a minimum the errors arising from inaccuracy in the determination of their atomic weights,—which errors, whilst they might on the one hand balance each other, on the other might accumulate in the same direction, and become a total error of exceeding magnitude in the atomic weight of the metal under investigation. The method adopted should also be one in which there is the greatest possible difference of weight between the substance taken for the starting-point and the one ultimately obtained; for the greater the amount of this difference, other things being equal, the less likely are the unavoidable errors incidental to the method, and which may be looked upon as constant, to injuriously affect the atomic weight obtained. For these reasons processes in which a weighed quantity of the metal itself is taken and converted into one of its salts seemed likely to afford the best results; and this, accordingly, is the principal method which I have adopted.

Every substance employed in such a determination is liable to introduce errors proportionate to its own want of purity. The most extraordinary pains have therefore been taken to secure the absolute purity both of the thallium employed and of the agents used to act upon it. The glass and other apparatus have been specially constructed for these researches, and the balances and weights have been of an accuracy never before surpassed in any research. Whilst nearly every other branch of manipulative chemistry has advanced to an accuracy vieing with astronomical observation, the operation of weighing, as almost universally carried out, is attended with grave imperfections. For ordinary analytical work, and perhaps even for more refined and accurate researches, the errors attending the ordinary process of weighing are unimportant; but in determining an equivalent so high as that of thallium no precaution whatever, which can either reduce an error to a minimum or eliminate it altogether, should be neglected. I am anxious to avoid the imputation of over-refinement in this research; but considering the fallibility of human operations, and especially those of so complicated a nature as I am about to describe, I have considered it better to err on the side of too great than of too little precaution, both in the purification of the chemicals, the arrangement of the apparatus, the time devoted to each separate determination, the removal of the errors incidental to the weighings, and the subsequent calculations. These latter have been especially tedious, as the numbers have generally extended to too many places of figures to allow the use of logarithms; each calculation has, moreover, been duplicated by different persons.

I have attempted two entirely different methods of arriving at the atomic weight of thallium. Had the results of these determinations differed materially, I should have extended the research to other methods; but as they nearly agree, it appeared unnecessary to incur so great an additional expenditure of time and material with no reasonable prospect of getting any but confirmatory results.

The first method, and that which I shall describe, consists in taking a known quantity of metallic thallium, dissolving it in nitric acid, and weighing the nitrate of thallium produced.

The second method consists in dissolving known quantities of sulphate of thallium in water, and ascertaining how much nitrate of barium is necessary to precipitate the sulphuric acid as sulphate of barium.

In the prosecution of these two methods, the materials

employed, the transferences from one vessel to another, and the weighings, are reduced to a minimum, while several precautions have been introduced into the operations of weighing which are not usually adopted. No correction has been neglected that is not many times less than the probable error of a single observation; and, as I have stated, especially has attention been paid to such corrections as always influence in one direction, as in that for weight of air displaced. Errors, sometimes in excess and sometimes in defect, tend to disappear from the mean of a great number of observations.

I have for the foregoing reasons thought it necessary to dwell thus far upon the care I have bestowed upon my work. In the succeeding section I shall describe accurately the apparatus employed, including the balance and weights, and the necessary arrangements for weighing *in vacuo*. In the third section I shall enumerate the chemicals and the methods of preparing them and pure thallium. The fourth section will be devoted to the process determining the atomic weight and the weights obtained. The concluding section will consist of a calculation and discussion of results.

Section II.—APPARATUS EMPLOYED.

The absolute weight of any substance may be found by calculation from its apparent weight in an atmosphere balancing 30 inches of mercury, and from its apparent weight under, say, 25 inches of mercury; but the errors of observation, more especially those relating to the maintaining of a partial vacuum, will largely affect the result. Weighings obtained in atmospheres balancing 30 inches of mercury and 5 inches of mercury respectively will give a more accurate result; but the best weighings whereby the absolute weight of a substance may be calculated are undoubtedly one in air at ordinary pressure and temperature, and one in a highly rarefied atmosphere,—it cannot be said *in vacuo*, owing to the difficulty of working under such a difference of pressure between the atmosphere of the balance and that surrounding it.

The Balances.

Two balances were used. That which I shall call the *air-balance* was made by Messrs. Keissler and Neu expressly for this work, and will clearly indicate a difference of 0.0001 of a grain when loaded with 1000 grains in each pan.* It is always kept in a dry room of tolerably uniform temperature, away from draught, artificial heat, or chemical vapours, and was (in the most accurate experiments) only used when no fire had been in the room for at least twelve hours.

The second balance, which I shall call the *vacuum-balance*, is almost a duplicate of the first, of 14-inch beam, with agate knife-edges and planes, made by Oertling. It is enclosed in a cast-iron case connected with an air-pump, and so arranged that I can readily weigh any substance in air of any desired density, the rarefaction being measured by a barometer-gauge. The accompanying diagram (Fig. 1) shows the method of the connections. The upper and lower portions of the iron case are connected by flanges and bolts; while, to ensure that the joint shall be air-tight, there is cemented to each flange a band of thick unvulcanised india-rubber, a lead wire being laid between the two pieces of india-rubber. By this means, and by causing the arm by which the riders are adjusted and the key liberating the pans and beam to work in a double-packed stuffing-box, a nearly perfect

* M. Stas employed four balances. One of them when loaded with 1000 grammes turns with 5-10ths of a milligramme; another when loaded with 5000 or 6000 grammes turns with 1 milligramme, and with 2000 or 3000 grammes in each pan turns with 3-10ths or 4-10ths of a milligramme; the third balance loaded with 500 grammes turns with 2-10ths of a milligramme; the fourth laden 25 grammes turns with 1-33rd of a milligramme. Reducing these weights to grains, we find that—

No. 1	loaded with	15,432 grains	turns with	0.0077 grain.
" 2	"	92,592	"	0.0154 "
" 2	"	46,296	"	0.0060 "
" 3	"	7,116	"	0.0060 "
" 4	"	386	"	0.0005 "

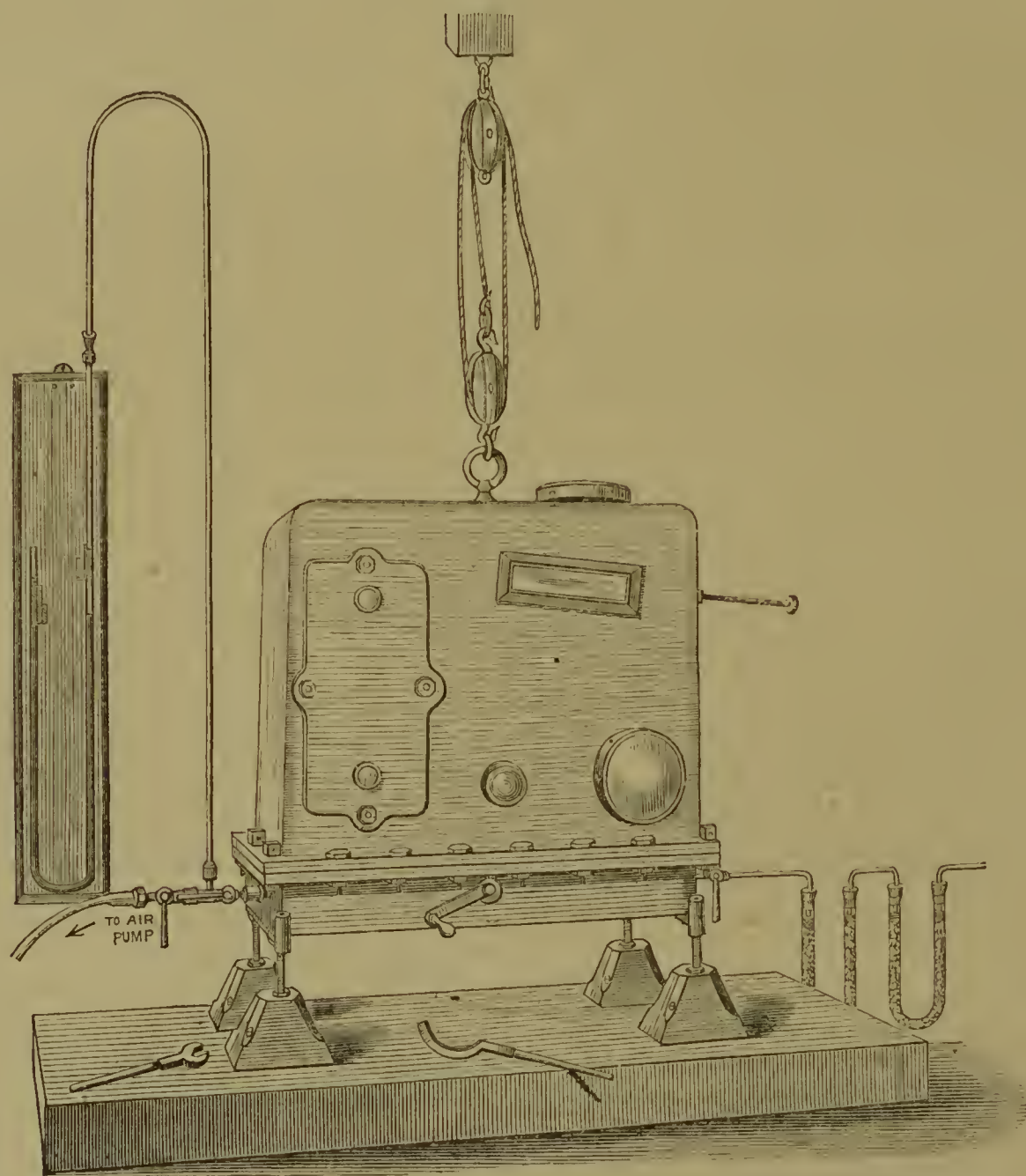
vacuum can be maintained. The openings in the metal work, through which observations are made, are fitted with clear stout plate glass; that to the left of the centre of the case, for the introduction of the apparatus, &c., is closed with an iron door, clamped and fitted with washers. The apparatus, when attached to the air-pump and exhausted to 25 inches of mercury, seldom allows the column of mercury to sink at a greater rate than 0.01 inch in an hour. A plug of gold-leaf is inserted in the tube, connecting the barometer-gauge with the vacuum-chamber, in order to absorb any mercury vapour that might otherwise be carried over.

Even with moderate rarefaction the iron case of the balance showed at first a certain amount of porosity, due to the "kish" or graphite, carbide, and silicide, diffused through the metal like a sponge. Cast-brass, and even drawn-brass, tubes exhibit a similar porosity. This porosity in

of the case are of well-greased leather, while the glass plates in the other parts of the apparatus are cemented into double frames with red lead.

At first it was attempted to put nearly the correct weight into the pan, and then make the final adjustment by means of the rider. It was, however, soon found that the more accurate method was to introduce a certain weight, and then to alter the pressure of the air until the balance shows equilibrium. Thus, supposing a glass vessel weighing in air 625.1200 grains has to be weighed *in vacuo*, calculation estimates the probable weight (*in vacuo*) at 625.3700. I therefore introduce rather less (625.3600) than this weight, and exhaust until the balance attains equilibrium, when the gauge shows an atmospheric pressure equal, say, to 3.75 inches of mercury. When this is obtained the weight is slightly increased or diminished with the rider, and the exhaustion varied until

FIG. 1.



the casing of the balance admits of easy remedy, by painting the whole surface with two or three thin coats of white-lead paint mixed with boiled linseed oil or fine copal-oil varnish, allowing each coat to dry before the next is laid on. The vessel should be painted when it is partially exhausted; the multitude of small holes then appearing in the smooth surface of the paint as it is forced inwards by the pressure of the outer air, should be covered carefully with thin coats of paint. When this effect ceases, a final thin coat should be given and allowed to dry.

The iron flanges were first planed true with the planing-machine, and then "fined off" by Whitworth's process of scraping, generally employed for such work as slides of engines, &c. The lead wire laid between the flanges of the iron case in india-rubber, becoming compressed when the bolts are tightened, effectually precludes the entrance of air. The washers of the iron door to the left

a fresh equilibrium is established. Two weighings at different degrees of atmospheric pressure, varying by a considerable interval, give data upon which to calculate with great accuracy what the weight would be in a perfect vacuum.

With a rider there is some difficulty in estimating the exact point at which it rests, and it is necessary to note the oscillations, placing the rider as exactly as possible on one of the divisions of the beam. The best weighings, perhaps, will be taken when the arc is not very small.

Temperature has an effect upon the air-balance, rendering it less sensitive when increasing. This is perhaps due to the varying expansibility of the arms and the knife-edges upon which the pans are hung, or the superior and inferior parts of the beam may expand unequally. The two arms of the balance at times expand unequally; and in finding the true value of the weights employed in the determination, this cause of error is eliminated by

following Gauss's method of interchanges—the constant friction of the forceps against the weights in transferring them from one pan to another being obviated by employing hooks of thin wire attached to the agate plane, upon which the suspension-wires of the pans could be hung. This required that the pans should not differ from each other by a quantity greater than one-thousandth of a grain.

In heavy weighings it is found convenient to remove one of the pans; but as the case is one of determining a weight and its increase after certain operations, the removal of the pan does not affect the result, provided the weight of the pan is accurately ascertained, and this weight allowed for, the apparatus weighed appearing lighter to an amount equal to this weight. Always when weighing different metals, or glass, or some chemical against metal, it is necessary to correct for the weight of air displaced, reference being at the same time made to the temperature and air-pressure; for assuming that there are to be weighed 7000 grains of bronze against 7000 grains of platinum, there will arise an error of nearly 0.6 of a grain unless this precaution be attended to, for 7000 grains of bronze displace roughly 1 grain of air, while 7000 grains of platinum displace only 0.4 grain.

At each weighing at diminished air-pressure care must be taken to allow the balance to remain at rest for at least half an hour, and preferably for several hours, in order to allow the temperature to become uniform after the alteration caused by the exhaustion. The weighings were always repeated a second time after everything had been allowed to remain at rest for one hour; and when the final weighing was made the case had been unopened for six hours, the adjustment being made by slightly altering the density of the enclosed air.

One of the greatest difficulties occurred in endeavouring to illuminate the scale and pointer of the balance without heating sufficiently to introduce a cause of error. The concentrated rays of a lamp were found to be unsuited in several ways. The use of a small vacuum-tube suspended inside the iron case was finally decided upon, sufficient light being obtained with two Grove's cells actuating a small induction-coil placed some distance from the apparatus, the electricity being conveyed by fine conducting wires of good copper, carefully insulated.* These wires pass into the case through grooves filed in the flanges and well protected with india-rubber bands, and in no way interfere with the obtaining of a vacuum.

To prevent parallax the scale and pointer are viewed through a small telescope having a vertical wire in the focus of the eye-piece. The observer is therefore able to be situated some eight or ten feet from the balance during accurate observations, thus reducing to a minimum the disturbance due to the temperature of the body. It is inexpedient to estimate the value of a division on the ivory scale over which the pointer of the balance travels, as its value varies with the length of arc of vibration, with the weight in the pans, and slightly with the temperature. It is also evident that Gauss's method of weighing in alternate pans is inapplicable when weighing in a rare atmosphere, owing to the number of times the case would have to be opened, and the consequent liability to other sources of error. Borda's method, as described by Péclet in his "Cours de Physique," gives the most accurate results with the least expenditure of time. The weights are placed in the left-hand pan, and the object to be weighed in the right. At the last three consecutive oscillations of the pointer along the divided scale the division reached by the pointer is recorded, and

$$\frac{a + c + 2b}{4} =$$

the reading of the scale when the balance attains equilibrium. It is better to allow the first oscillation to occur

unnoticed, and to record only the next three consecutive oscillations, while the first can be employed to check the result if required.

Finally, the balance-case contains a jar of pure oil of vitriol exposing a large surface, and another of caustic potash. The air is admitted through long U-shaped tubes, one filled with chloride of calcium, and the other with platinised asbestos.

For each weighing all necessary observations of the barometer and thermometer were made, as will be found noted in the fourth and fifth sections of this memoir.

(To be continued).

FLUORESCENT RELATIONS OF THE BASIC SALTS OF URANIC OXIDE.*

By HENRY MORTON, Ph.D.,
President of the Stevens Institute of Technology.

IN the course of some experiments upon the effects of heat in modifying the fluorescent spectra of uranium salts, the following action was observed.

A little ammonio-uranic oxychloride, somewhat moist and having a little adherent hydrochloric acid, was heated in a test-tube in the flame of a spirit-lamp until it fused and gave off a little vapour. This treatment being repeated, a portion of the material became solid and opaque even while the rest was fused, and on cooling was found to fluoresce brightly with a continuous spectrum.

Some time after, on heating a neutral solution of uranic acetate to 100° C., a precipitate formed, which on draining and drying showed by fluorescence a continuous spectrum crossed by bright lines. By a slight washing a portion of this was obtained yielding a continuous spectrum only.

Again, while drying some sodio-uranic sulphate at 150° C. a portion placed suddenly in the oven in a moist state was found to yield a continuous spectrum by fluorescence like the others.

These experiments, however, yielded such small quantities and were so uncertain of repetition, that the obvious plan of analysing the bodies to determine their nature could not be well applied.

A little reflection suggested that the body present in all these cases might be a basic salt, as the uranic hydrates were excluded by the fact that they were without fluorescence.

I therefore attempted to make some basic sulphate, in the manner described by Prof. J. M. Ordway, *i.e.* by treating the normal sulphate in solution and cold with excess of barium carbonate. (*Am. Journal*, 1858, vol. xxvi., p. 208).

In the first attempt, however, to add an excess of barium carbonate to the uranic sulphate, all the uranium was precipitated. On the chance of repairing this misfortune some sulphuric acid was cautiously added, until a yellow colour appeared in the solution above the precipitate, and this solution was then concentrated on the water-bath.†

It refused to crystallise, but finally dried to an amorphous solid of a rich yellow colour, perfectly soluble and fluorescing with a continuous spectrum. On determining the sulphuric acid in this, it was found to correspond with what calculation called for in a salt having the formula $3(\text{U}_2\text{O}_3)\text{SO}_3 + \text{Aq}$.

Reflection upon this result suggested that the basic salts might be made not only by removing part of the acid from the normal ones, as in the method followed by Ordway, but also (as in the above case) by direct action of the acid upon the fresh and moist uranic hydrate, for it

* Communicated by the Author.

* At high rarefactions this method of illumination fails, owing to the induced current passing between the wires outside the vacuum tube.

† The barium carbonate here used was freshly prepared and moist. Some of the same quantity afterwards dried refused to react with the uranic sulphate.

was evident that the substance here concerned was none other than this.

To follow out this idea, I therefore prepared some hydrated uranates of potassium, sodium, and ammonium by adding the bases or their carbonates to solutions of uranic nitrate.

To different portions of each of these uranates, I then added sulphuric, nitric, hydrochloric, and acetic acids, in all cases stopping short of saturation, or after saturation adding more of the uranates until a portion remained undissolved.

In this way series of compounds were formed, all of which on evaporation to dryness yielded continuous spectra by fluorescence, though in some cases this was combined with a banded spectrum. The brightness of this action, however, varied greatly in the different salts in accordance with the variation in the second base as well as with the acid. Thus the salt formed by dissolving the ammonium uranate in hydrochloric acid had a very rich fluorescence (like that of the material first obtained by fusing the ammonio-uranic oxychloride), while the substance yielded by solution of the sodium uranate in the same acid showed a very faint fluorescence, resembling in this respect a specimen of basic uranic oxychloride prepared by Ordway's method. Remember that an ammonio-uranic oxychloride forms with great ease, while a corresponding sodium salt has resisted repeated attempts at its formation, we would be naturally led to conclude that we here had to do with a basic double salt in the case of the ammonium compound, and a simple oxychloride of uranium mixed with chloride of sodium in the case of the other.

When the solutions of various uranates in acids as above described are heated, they throw down copious precipitates, which also yield a continuous spectrum. These precipitates were drained on a filter without washing, as they are soluble in water.

A series of analyses was then made of the solutions as first prepared of the precipitates thrown down by heating to 100°C . and of the filtrate from this last.

Although the figures so obtained were in some cases to be considered only as approximations (the substances operated upon being more or less mixed), yet they pointed clearly to the following conclusions:—

1st. That the precipitates obtained by boiling the basic solutions were basic salts having such a formula as $3(\text{U}_2\text{O}_3), \text{SO}_3 + \text{RO}, \text{SO}_3 + \text{Aq}$.

Thus in the case of the ammonia salt we should have $3(\text{U}_2\text{O}_3), \text{SO}_3 + \text{NH}_4\text{O}, \text{SO}_3 + 6\text{HO}$, or developing into a percentage form and comparing with the results of analysis—

Calculated.	Found by Analysis.
$3(\text{U}_2\text{O}_3) = 73.0$	74.0
$2\text{SO}_3 = 13.5$	12.3
$\text{NH}_4\text{O} = 4.4$	4.8
$6\text{HO} = 9.1$	8.5
—	—
100.0	99.6

This shows us quite as satisfactory an agreement as we ought to expect when we remember that the substance was simply drained on the filter with the Bunsen pump without washing.

2nd. That the solution first formed corresponded very nearly with the above salt united with one molecule of the normal or neutral double sulphate.

3rd. That the filtrate from the precipitate consisted of the normal double salt holding a slight excess of base in solution.

4th. That the freshly prepared uranic hydrate or uranate is in a sufficiently active state to combine with acids in a higher proportion than that of the neutral salt, or, if not so combining, at all events to dissolve in the solution of the normal salt.

5th. That all the basic salts of uranium are distinguished by fluorescing with a continuous spectrum, and

that we have in this a valuable means for discriminating between a basic salt and a precipitate of uranic hydrate.

Thus, it is generally stated, that, if the neutral solution of uranic acetate is heated, the precipitate thrown down is uranic hydrate. Such, however, as appears from the second experiment narrated at the outset, is not always the case, and in any instance the spectroscope will enable us to decide by a simple observation as to the nature of the substance in this respect.

Yet again, this enables us to confirm and localise an observation of Becquerel's, which might otherwise seem less satisfactory.

Thus, in the *Annales de Chim. et Phys.*, 1872, vol. xxvii., p. 546, he refers to a salt obtained as a precipitate on allowing a solution of impure uranic nitrate to cool. He names this "an ammoniacal subsulphate of uranium," and gives as the result of two analyses the following:—

$\text{U}_2\text{O}_3 = 4$	} or reducing this into percentages.	47.6
$\text{SO}_3 = 2$		23.8
$\text{NH}_3 = 1$		11.9
Water = 20 p. c.)		16.6

This composition, allowing for its evident want of precision, is not unlike that of the solution first obtained by dissolving the uranate of ammonia in a minimum quantity of sulphuric acid.

The peculiar fluorescence noticed by Becquerel is then probably due to the presence of the basic salt—



in the more or less mixed material which he examined.

He also states that he obtained accidentally analogous deposits in the preparation of some double sulphates, but he did not analyse them or follow up the subject further.

The subject of the actual condition of the solution first formed, and its relations to the neutral and basic salt, is now under investigation, and gives promise of interesting results.

All these solutions show banded spectra of fluorescence and absorption, which suggests the idea that they are rather mixtures than compounds, as has been before shown in the case of other double salts.

From the above observations generally, we see that basic salts of uranium are found under a great variety of conditions, some of which would be hardly regarded as favourable for such a development.

ON HEAT.*

By FREDERICK GUTHRIE, B.A., F.R.S., &c.

THE subject of this Lecture was "Latent Heat, and Heat in its relation to the Solid, Liquid, and Gaseous states of Matter."

The results obtained in determining specific heat by the method of mixture, and referred to water as a standard, taking equal weight, were first glanced at, and one especial point noted.† Taking into consideration what chemists call the combining weight of the elements, and considering all matter to be made up of atoms, let us conceive that these atoms have different weights, and that the combining weight of the elements are nothing more nor less than the weights of the atoms; then we find this remarkable circumstance that the product of the specific heat into the combining weight presents so great an equality for all the elements—whether solid, liquid, or gaseous—that it approaches to identity. As the result of that supposed identity, granting that the non-identity is due to imperfect experiments, or to the possibility of one and the same

* Abstract of the fourth of a course of Lectures to Working Men, delivered in the South Kensington Museum on Monday, the 8th ult.

† In the case of gases, however, two units of comparison are used, H and air. H is perhaps the most scientific, air the most useful for experimental purposes, because it is so universal in its distribution. The comparison between the results obtained by taking H and air is easy to perform, if one determines the specific heat of the gas H, and the mixture of gases, air.

element occurring in different forms, as in C, P, and S, we are at liberty to assume the following as a most elementary fact, *that to heat an atom of any substance, the same number of degrees requires the same quantity of heat.* Thus you see that a substance like H, which has the lowest of all atomic weights, requires for a given weight the greatest quantity of heat to raise it through the same range of degrees. So, looking over the list, we find that those bodies with the highest atomic weight have the lowest specific heat, in such a manner that, when the two are multiplied together, the product is a constant. Hence, if we determine the atomic weight of an element, we determine thereby its specific heat, assuming this law to hold good.

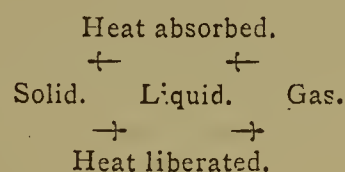
Recurring to the illustration of filling a body with heat, to the filling of a vessel with water, imagine a cylinder of a certain capacity with two side cisterns of any capacity leading out from it, the one above the other; and if we pour water into such a compound vessel, the vessel will be filled till it gets up to the mouth of the first cistern, then all the water poured in will go to fill this, and until that is done no further rise in the level of the water will take place; and so on till the mouth of the second cistern is reached, and when that is filled, the rise will go on as before. The mouths of these two cisterns find their analogy in matter at the melting- and at the boiling-point. When heat is applied to a solid, it gets warmer until it begins to melt. As long as any of the solid remains unmelted, the heat which is continually being poured into it melts, but does not heat it. It does not become sensible heat, but it changes the state of the solid, and becomes latent heat, which is not apparent to the thermometer. Thus, if we take a mixture of ice and water, and warm (put heat into it), as long as there is ice present the temperature remains the same. Hence, the temperature of melting ice is taken as a fixed temperature, because we have a large margin or equality of temperature. The heat which goes into the ice without warming it is called "heat of liquefaction." Again, the liquid so obtained, or another on receiving heat, becomes warmer until the liquid boils. As long as any liquid remains, the heat which enters it does not become sensible, but changes the state of the liquid, and is sometimes said to be latent in the vapour. Such heat is heat of vaporisation. The heat of liquefaction is given out or withdrawn when the liquid freezes; the heat of vaporisation is given out when the vapour condenses.

Consider first the latent heat of steam, then of water. The latent heat of steam can be determined in the following simple way. Take, say, 100 grms. of ice-cold water and pass steam into it until the water is at 100° C. In doing so 10,000 heat-units will be employed (100 times 100) and the steam being at 100° as it passed out of the boiler will not have lost any temperature because it will be converted into water, but it will have lost a certain number of units of heat to raise the 100 grms. of water from zero to 100° C. Then find the increase in weight due to the condensation of the steam, that steam having the same temperature as boiling water, but having given up its latent heat, which has been sufficient to raise 100 grms. of ice-cold water to 100° C. This increase shows the quantity of steam that condensed and did this amount of work, heating this quantity of water to these degrees. Dividing the number of heat-units employed (10,000) by the quantity of condensed steam gives the number 536, being the grms. of water which can be raised 1° C. by the condensation unaccompanied by cooling of 1 grm. of steam.

In a similar way the latent heat of water is obtained. Take first 200 grms. of ice-cold water and pour upon it 200 grms. of boiling water; of course there will be 400 grms. of water and the temperature will be 50°. Next take 200 grms. of ice, not cooler or warmer than the ice-cold water, just melting in fact, and pour 200 grms. of boiling water upon it, then the temperature produced is not 50°, but something less, because a considerable number of the heat of the water will be used in melting the ice and not in

warming it. In this way by pouring 200 grms. of boiling water upon 200 grms. of ice at a temperature of, say 12° C. will be obtained when the ice is melted. Thus 200 grms. of boiling water in falling to 12° have given up 88 times 200, or 17,600 heat-units. These heat units have melted 200 grms. of ice, and raised the molten ice to 12°. In the latter operation 12 times 200, or 2400, heat units have been employed; there remains, therefore, 17,600—2400, or 15,200 heat-units which have been expended in merely melting 200 grms. of ice. Therefore, to melt 1 grm. of ice, 76 units of heat are necessary. Accurately measured the latent heat of water is 79.25. The latent heats of different vapours and liquids are determined by modifications of these experiments not convenient to enter into now.

Closely connected with the determination of the latent heat of bodies, *i.e.* of liquids and gases, is the relation between the three forms of matter—solid, liquid, and gaseous—and the heat which either determines the change from the one state to the other, or which accompanies the change. The relation between heat, and the solid, liquid, and gaseous states of matter may be expressed by the following scheme:—



Which represents the following facts. (1) By giving heat to a solid you may fuse or melt it, thus converting it into a liquid—as when lead is put in the fire, it melts. (2) By giving heat to a liquid you may vaporise it, as by putting a kettle of water on the fire, the water evaporates. (3) By taking heat from a vapour or gas you may liquefy it, as a cold plate gets hot and wet when placed in the steam from the kettle. (4) By taking heat from a liquid you may solidify or freeze it, as water exposed to cold air freezes. Again, the above scheme expresses the four analogous facts. (5) When a solid liquefies, it absorbs heat, as when salt or saltpetre is put into water, the mixture is cold or in the act of absorbing heat. (6) When a liquid vaporises it absorbs heat, as water or ether on the hand makes it feel cold; it evaporates and absorbs heat. (7) When a vapour or gas condenses or liquefies, it evolves heat, as when a gas very soluble in water is passed into water, the water becomes hot. (8) When a liquid freezes or solidifies, it evolves heat, as a super-saturated solution of a salt on solidifying gives out heat. Various illustrative experiments were given here: one may suffice. A most striking example of the absorption of heat when a liquid passes into the gaseous state is presented by the liquid carbonic acid. The cold thus produced (the heat thus absorbed) by the vapour of the liquid is so great as to deprive the remainder of the liquid of so much heat that it become solid. A frozen residue can thus be obtained which is solid carbonic acid. By putting this in any gealable liquid such as ether, it will be cooled, not frozen, and any substance in contact with the pasty mass—mixture of ether and carbonic acid—is frozen. Hg was frozen by this means, and the frozen Hg, plunged into ice-cold water, froze the water, while the Hg itself melted.

By converting solids into liquids also, we get a considerable amount of cold, *i.e.*, they absorb a great quantity of heat. Supposing we take a mass of salt and bring it in contact with the ice; there is a tendency for the salt to dissolve in water, and water will be formed by dint of the tendency of the salt to dissolve in water, the ice will melt to dissolve in the salt, and the salt will melt in the dissolving ice; therefore, heat is absorbed. When you scatter salt upon ice or snow, it melts, though it is not warmed, but, on the contrary, cooler to the hand than the snow itself. You force these two solids to take the liquid form, and heat is absorbed from any substance in

contact with these. That is the theory of freezing mixtures.

Again, all liquids endeavour to vaporise. When a liquor rises in vapour, it has to displace the air which presses on it. If the air be removed, the vapour rises more freely, and consequently the liquid and bodies touching it lose heat more quickly. Accordingly water can be frozen by quickly removing the vapour which arises from it, and this may be done by the air-pump, or by freezing the vapour. Take a sealed tube containing nothing but water, and the vapour of water, obtained by sealing, when boiling, and remove the vapour of water by cooling the tube. You can withdraw the heat from the vapour of water by a freezing mixture, and then as ice it will not occupy the same space as vapour of water, and no longer press with the same force. More vapour will rise from the water, but only to be condensed in the bulb by giving up its heat to the mixture of ice and salt. It will, therefore, continuously evaporate, and the result is it passes from the liquid to the gaseous state. That vapour of water as it rises carries the heat with it as vapour, to give it up to the freezing mixture, to melt that freezing mixture, and the water which gives up the heat ultimately freezes. This is the principle of the cryophorus or frost-bearer, but it might justly be called pyrophorus or heat-bearer, because really it is heat which travels.

When liquids are exposed to the air, three main forces act upon them. (1) The liquid strives to become a vapour, and to penetrate the air. (2) The pressure of the air restrains such a rise. (3) The force which assists the pressure of the air, or which acts against the diffusive tendency, viz., cohesion. If we diminish the latter force by so applying heat that the water swells, and its particles get further apart, we assist the evaporation. If we keep pouring heat into the liquid, so that the cohesion is kept continually below a certain amount, the liquid is rapidly converted into a vapour, the water boils. Or if we keep the temperature constant, and diminish the pressure, some liquids may be made to boil. At a given pressure different liquids boil at different temperatures, or have different "boiling-points."

The tendency which liquids have to pass into the vaporous state is called vapour tension, and it is measured by the effect which the liquids have in depressing the Hg in the barometer. Three liquids, viz., water, alcohol, and ether, are introduced into three similar tubes full of Hg to about 30 ins., and it is seen from the amount of depression that the vapour tension of ether at the same temperature is greater than that of alcohol, and that of alcohol greater than that of water and the tension of water greater than 0 (nothing) or ordinary barometer.

LIMITS OF ACCURACY ATTAINABLE IN ORDINARY WEIGHING.

By CHARLES W. FOLKARD.

It seems to me that the remarks made by Fresenius, in his "Manual of Quantitative Analysis" (sixth English edition), relative to weighing, are liable to mislead. In page 18 he says—"Where absolutely accurate results are required . . . the weight of the corresponding volume of air must be added respectively to that of the substance and of the weights, making thus the process equivalent to weighing *in vacuo*." Again, in page 17,—"A few minutes will generally suffice to ascertain the weight of a substance to within $\frac{1}{10}$ of a milligramme." He thus makes weighing to this degree a general rule, whereas the correction for air is required only in absolutely accurate results.

Now it occurred to me that *bona fide* weighings to $\frac{1}{10}$ th a milligramme would probably necessitate this correction, and I therefore made the following calculation, which seems to apply to many cases of quantitative analysis:—

A large platinum dish for water analysis weighs 75 grms.

The weights are of brass.

The specific gravity of platinum is 21.5.

" " brass is 7.0 (average).

Consequently the bulk of air displaced by the brass is three times that displaced by the platinum; but as this air is displaced when the dish is weighed with its water residue, as well as when empty, it is manifest that it would not affect the results provided its weight, and consequently its temperature and pressure, remained the same. Now the evaporation of a litre of water on the water-bath takes a day or a day and a half, and it will be granted that the pressure may fall $\frac{1}{2}$ an inch in that period and the temperature rise say 11° C.

Now 1 c.c. of water weighs 1 grm.; therefore 1 c.c. of brass weighs 7 grms. (sp. gr. = 7.0); therefore the 75 grms. of brass have a bulk of 10.7 c.c.

So the bulk of air displaced by the weights is 10.7 c.c., one-third of this being compensated for by the volume displaced by the platinum; consequently the remaining two-thirds only are to be considered $10.7 \times \frac{2}{3} = 7.13$ c.c.

Now 1 litre of air weighs 1.293187 grms.; } at 0° C. &
consequently 7.13 c.c. weigh 0.00922 grm.; } 760 m.m.

If the barometric pressure fall $\frac{1}{2}$ inch = 12.5 m.m., this is $\frac{12.5}{760}$ of the whole pressure = $\frac{1}{61}$. Now the 7.13 c.c. of

air weigh 0.00922 grm., and by this diminution of pressure will weigh $0.00922 \times \frac{60}{61} = 0.00915$ grm. less. Therefore the weights being buoyed up by 0.00015 grm. less, the dish will apparently weigh $\frac{1}{61}$ -tenths of a milligramme more than before.

Also, if the temperature rise from 0° C. to 11° C. (which would often happen in winter), the 7.13 c.c. will expand $\frac{1}{273}$ of its bulk, and its weight will be decreased $26 : 25 = \frac{1}{25}$ part.

Now $0.00922 \times \frac{1}{25} = 0.00035$ grm., and the dish will apparently weigh more by this amount.

So by these unprovided for circumstances the weighing varies two or three tenths of a milligramme; therefore, I ask, what is the use of getting within $\frac{1}{2}$ a milligramme? It is needless to remark that no chemist would think it necessary to apply these corrections in ordinary analyses. The aqueous vapour, and consequently the amount of hygroscopic moisture, would probably also exert an appreciable influence.

PROCEEDINGS OF SOCIETIES.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, October 30th, 1873.

Dr. LUNGE, President, in the Chair.

THE SECRETARY read the Committee's report and Treasurer's statement:—

The PRESIDENT then delivered his address, in the course of which he made the following remarks:—

Gentlemen,—My first duty, on welcoming you at the commencement of a new session, is to thank you for again conferring upon me the distinguished honour of presiding over your meetings during the ensuing winter.

Some of you no doubt have, like myself, paid a visit to the great International Exhibition at Vienna, the largest the world has as yet seen; but as, most likely, the majority of our members have not done so, it may not be uninteresting to them if I make a few remarks upon chemistry as represented at the Vienna Exhibition. That remark which first obtrudes itself upon me, must needs be uppermost in the mind of every English visitor to that part of the Exhibition, viz., that this country, still undoubtedly the largest centre of manufacturing chemistry in the world, would seem to be on a level, or scarcely on

a level, even with Italy or Holland, as represented at the Exhibition. Only one alkali works on the Tyne and two in Lancashire appear as exhibitors, and there are only half-a-dozen cases or so besides representing the chemical industry of this country. It is not my place here to discourse upon the reasons which may have influenced the bulk of British chemical manufacturers in holding aloof from the Vienna Exhibition, reasons which anyhow have not prevailed with the chemical manufacturers of any other country, nor, indeed, with most of the other branches of British industry; but the result is anyhow an impression in the mind of foreign critics that there is not very much progress to report in the British chemical industry, at any rate since 1867, the year of the Paris Exhibition. Such an impression, whether justified or not, is undoubtedly heightened by the great public spirit with which Germany and France have exhibited in this branch, not to speak of the really surprisingly varied and good chemical exhibition of Austria, since Austrian manufacturers might be expected to be on their mettle and do the best they could for an Exhibition in their own capital. Be that as it may, they have proved that even in that remote corner of Europe, with dear coals and comparatively very bad communications, a chemical industry has sprung up of the extent and variety of which perhaps few people in this country previously had a full idea. In stearin, paraffin oils, and soaps, Austria seems abreast with the best works abroad; a finer alkali works than that at Aussig, conducted by Dr. Schaffner, might be sought for in vain in this country; but even the more delicate chemicals are made largely in Austria, and of very good quality. Still, Austria is only in the second rank of chemical industry, even in the Exhibition, where the first rank can be only disputed between France and Germany. The exhibitions of both these countries are extremely fine and prove a most important advance since 1867. This particularly refers to the manufacture of coal-tar dyes, especially in the totally new branch of anthracen dyes. A good number of factories exhibit artificial alizarin, for which one single works in Germany is preparing plant for turning out the stupendous quantity of 100 tons per week. But also in many other branches, the most delicate chemicals which have only been produced in quantities of grains in the laboratory of some professor a few years ago, appear at the Exhibition in pounds, and at the factories in tons. It is somewhat humiliating to this country that the raw material for these beautiful preparations is, to a great extent, imported into Germany and France from England, and the manufactured articles are exported by them again to this country. The number of exhibitors and of articles exhibited in this special field alone is so large that I cannot attempt to go into any details, much as the subject would tempt me to do so, but I cannot refrain from contrasting the splendid array of glass cases filled with fine chemicals and dyes from France, and more particularly from Germany, with the comparatively small display which could have been made by England, even if it had seen fit to display at all. Unless this state of affairs is greatly altered, England will be left behind altogether in anything but what I might call the grosser kind of chemicals. The reason is not far to seek. You find in every chemical works on the Continent, I may say, without exception, one, sometimes several, chemists of thoroughly scientific training, who have acquired their theoretical basis by three or four years' studying at a University or a Polytechnical Institution. One works, to which I have already alluded, certainly one of the largest in Germany, keeps something like half-a-dozen such chemists (not practical managers), with salaries varying from £300 to £400, and it retains the services of an accomplished chemist, of scientific reputation, at a salary of nearly £2000 per annum, exclusively for theoretical work in the laboratory, without any trouble or responsibility connected with the manufacturing work outside. But then, they *do* constantly invent new things there, and make them in tons, or hundreds of tons, when the

chemical world outside, has perhaps, barely heard of the discovery of a new compound, with a barbarous name, apparently only obtainable at the rate of a few grains in a sealed tube after many weeks' patient work. Of course, I do not mean to say that chemical industry, even of this finer kind, is not existing in this country; a mention of the firms of Perkin, of Roberts, Dale and Co., and many others, would be an instant refutation of such an absurd assertion; but what I maintain, after a visit to the Vienna Exhibition, and at a few German and Austrian chemical works, is, that foreign countries are taking the wind out of our sails very fast in this line, and that both their rate of progress and the means of attaining it are very much superior to ours.

For one country it is possible to give pretty reliable details, viz., for Germany, as considerable pains were taken by the German Commission to embody with their special catalogue a digest of all statistics they could accumulate. From the introduction to the chemical part of the German Exhibition, drawn up by the most competent hand of Dr. Hofmann, it appears that, to give just a few items, within the six years from 1867 to 1872 the German production of sulphuric acid has increased from 57,825 tons to 84,264 tons; sulphate of soda from 35,767 to 51,618 tons; soda-ash (calcined) from 26,250 to 36,227 tons; saltpetre from 3024 tons to 5311 tons; superphosphates from 1000 to 6850 tons per annum, as far as the returns go, which are very incomplete. A specifically German industry is that of Stassfurt potash salts, made from the "Abraumsalz" (waste salt) of the salt mines. It commenced in 1861 with 2360 tons; in 1863 already 64,400 tons; in 1867, 167,500; and in 1872 as much as 506,420 tons of this material were worked up in thirty-three factories. The articles manufactured from it amounted (in 1872) to 50,000 tons potassium chloride, (commonly called "muriate of potash"); 62,500 tons potash salts for manure; 2500 tons sulphate and carbonate of potash; sulphate of magnesia (both crystallised and anhydrous): 12,500 tons; magnesium chloride, 6500 tons; sulphate of soda (crystallised from the mother-liquor during the cold of winter), 7500 tons; boric acid, 20 tons; bromine, 35 tons. Another cluster of factories exists in Prussian Saxony for the manufacture of mineral oils and paraffin from brown coal (lignite), which turned out in 1871 5000 tons paraffin, 15,000 tons lamp oil, and 4500 tons heavy oils, and it is a good testimony for the technical progress made in this branch that the value of those articles only amounted to £600,000, whilst the prices of 1861 would have made it equal to £1,000,000, and yet the profit to the manufacturer was larger in 1871 than in 1861. To pick out a few other items: Germany produces 4000 tons white lead; 12,500 tons zinc white; 500 tons chrome green; 7500 tons ultramarine (worth £600,000), in which article it has almost the same pre-eminence as in most other colouring materials artificially produced. But most remarkable is this pre-eminence in coal-tar dyes. Of aniline colours Germany produces already now quite as much as all the remainder of Europe taken together (inclusive of England), amounting in 1872 to a value of a million and a-half sterling, and I can testify from personal knowledge that this production is expanding immensely at this moment, but it certainly is almost put in the shade by the gigantic development of the trade in artificial alizarin. This latter product, which was only discovered in 1868 by two purely theoretical chemists, Graebe and Liebermann, in that most theoretical way which used to be sneered at not many years ago by so many "practical" people in this country, has already led, in 1873, to a production of 1100 tons, value £600,000, but one single works in Germany (there are ten or twelve in Germany, and one each in England and France) is now preparing for a production of 5000 tons of alizarin paste per annum. Some of my hearers may possibly compare this with the turn-out of our alkali works, and think it not so very grand after all; but artificial alizarin is the outcome of intricate con-

secutive reactions in organic chemistry, and involves, quite apart from the highest chemical knowledge, a plant and capital at least equal to thirty, if not to fifty, times its weight of soda-ash. I just mention this to give an idea of the rate of progress in the manufacture of finer chemicals on the Continent. The same progress takes place in another industry which is altogether unknown in this country, viz., the manufacture of beet-root sugar; from 1400 tons in 1837 it had expanded to 263,000 tons in 1871 in Germany alone, accompanied by an increase of 150 per cent in the amount of sugar consumed per head between these dates.

I need not point out to you how interesting it would have been if other countries had followed the example of the German Commission in making their Exhibition Catalogue at the same time a most valuable exposé on the whole industry of the nation; but even in the absence of such accurate material for comparisons, it seems beyond any doubt that in one branch of chemical industry this country is still far ahead of all others, viz., in the manufacture of alkali, with all its introductory stages and subsequent ramifications, and this refers not only to the magnitude of the manufacturing operations, but also to the number of improvements and new inventions relating to this subject. From this country have emanated condensing towers, lixiviating tanks, revolving soda furnaces, Weldon's manganese recovery, Deacon's chlorine process, to mention only a few things; but, apart from such single landmarks, I have no doubt that the whole style of alkali-making in this country, the shape of furnaces, the size of the batches, the details of working, are superior to those generally in use either in France or Germany. In the latter country I have found here and there complete imitations of the English method, as it is always distinctly called there, and it has answered so well that I consider it very likely it will be more generally adopted there. I may truly say that the English method seems to answer better in Germany than even in its own country, as far as the quality of the produce is concerned, and I can find no other explanation for this strange fact but the close supervision by trained chemists on the one hand, and the greater sobriety and docility of the men on the other hand. But it is again an English process which now causes the greatest stir among German alkali-makers, and which is believed by the International Jury at Vienna (whose president was Dr. A. W. Hofmann), perhaps too sanguinely, to be likely to supplant Leblanc's process in the immediate future. As this process is only being carried out by one works in England, which, I believe, is not even as yet in operation, it may perhaps not be out of place to conclude my remarks with a few words on it, although my hearers will probably take a less sanguine view of it than the Jury at Vienna. No doubt you will all guess that I am referring to the so-called ammonia process, which was first patented in this country in 1838 by Dyar and Hemming, but soon abandoned again. In 1854 it was vigorously taken up again by the celebrated chemist, M. Schloësing, of Paris, and M. Roland, of the same city. They introduced very considerable improvements into the process, but were so much hampered by the State monopoly for salt existing in France that they gave up the manufacture. Later on MM. Margueritte and Sourdeval, of Paris, and Mr. James Young, of paraffin celebrity, patented fresh improvements, and in 1867 Messrs. Solvay and Co., of Couillet, in Belgium, already exhibited soda made on a manufacturing scale by the ammonia process. The last improvements made by that firm, and further on by Mr. Honigsmann, of Aachen, and Professor Gerstenhöfer, of Freiberg, seem to have brought the process to such perfection, that in this country, as above-mentioned, but to a much larger extent in Germany and Switzerland, many factories are in the course of erection, one of them for a production of nearly 100 tons of soda-ash per week. Unfortunately, it is as yet kept a secret which are those particular improvements that have made the process a success, but it is not likely that such

a secret will be kept very long. As everybody knows, the process consists in saturating a strong solution of common salt with ammonia and carbonic acid at the same time, thus producing bicarbonate of soda as a precipitate and a solution of ammonium chloride, from which the ammonia is recovered again. All chlorine is wasted in the shape of calcium chloride, and for this reason alone the process, in this shape at any rate, could not do away with the ordinary process, for chlorine products surely will be required as much as ever. Possibly that objection might be overcome by substituting magnesia for lime, and converting the magnesium chloride into magnesia and hydrochloric acid again, but that is rather in the future. If the ammonia process really should be the process of the future, it is quite evident that those localities will have the best chance for it where strong brine is to be had for next to nothing, and that the manufacture of alkali will shift to different localities from the present. I do not mean to frighten any of my hearers with this hint, but only to exhort them to keep a sharp look-out for what is doing elsewhere, and by using every care, and adopting every improvement in the present process, which has so far outlived every other proposal, to make it able to compete with any other process in future as well.

NOTES AND QUERIES.

Benzole.—500 gallons of Scotch crude naphtha yield 25 per cent of distillate at 120° C. I should be glad to know how much refined benzole, yielding 90 per cent of distillate at 120° C. it should have produced. Theory and practice appear to disagree.—SCOTIA.

Zinc and Chromium Greens.—Could you obtain for me any reliable information concerning the manufacture of zinc green and chromium green for paint. Large quantities are yearly imported from Germany, and but little is known on the subject in this country. A reference to any articles which may have appeared in your paper or any other would kindly oblige.—E. D.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 12.—Medical, 8.

Geographical, 8.30.

TUESDAY, 13.—Royal Institution, 3. Prof. Rutherford, M.D., "On Respiration."

Civil Engineers, 8.

Anthropological, 8.

Photographic, 8.

WEDNESDAY, 14.—Society of Arts, 8.

THURSDAY, 15.—Royal Institution, 3. Prof. P. M. Duncan, F.R.S., "On Palæontology, with reference to Extinct Animals and the Physical Geography of their Time."

Royal, 8.30.

Royal Society Club, 6.

Chemical, 8. Dr. Gladstone and A. Tribe, "Researches on the Action of the Copper-Zinc Couple on Organic Bodies (No. V., On Ethyl Bromide)." Dr. M. D. Tommasi and R. Meldola, "On the Action of Trichloroacetyl Chloride upon Amines (No. I., Action upon Aniline)."

FRIDAY, 16.—Royal Institution, 8. Weekly Evening Meeting.

Royal Institution, 9. Prof. Tyndall, D.C.L., LL.D., F.R.S., "On the Acoustic Transparency and Opacity of the Atmosphere."

SATURDAY, 17.—Royal Institution, 3. Prof. G. Croom Robertson, "On Kant."

TO CORRESPONDENTS.

ERRATUM.—Vol. xxviii., p. 282, line 4 from top, for "Traverella" read "Traversella."

R. S.—"Select Methods in Chemical Analysis." Apply to our publisher. The price is 12s. 6d.

E. L. Gowthorpe.—"Chelt" will probably see your advertisement; we cannot insert your reply to his query.

BOOKS RECEIVED.

Substance of the Work entitled Fruits and Farinacea the proper Food of Man. Edited by Emeritus Prof. F. W. Newman, for the Vegetarian Society. Manchester: John Heywood. London: F. Pitman.

Questions in Chemistry and Natural Philosophy. Given at the Matriculation Examination of the University of London from 1864 to June, 1873. By C. J. Woodward, B.Sc. Simpkin, Marshall, and Co.

The Ocean: its Tides and Currents and their Causes. By W. L. Jordan. Longmans, Green, and Co.

SUPPLEMENT
TO
THE CHEMICAL NEWS.
VOL. XXIX. No. 737.

NOTICES OF BOOKS.

Milk-Analysis: a Practical Treatise on the Examination of Milk and its Derivatives, Cream, Butter, and Cheese.
By J. ALFRED WANKLYN. London: Trübner and Co., 57 and 59, Ludgate Hill. 1874.

UNTIL recently the analysis of milk had been in anything but a satisfactory condition, as may be judged of by reference to Goppelsröder's elaborate paper, published in Switzerland in the year 1866, and as, indeed, is quite notorious.

In the little work before us Mr. Wanklyn endeavours to do for milk-analysis that which he, in conjunction with Chapman and Smith, has already done for water-analysis. The book in question is designed specially for the use of the public analysts and medical officers of health; but we think it will have interest even for chemists who are not public analysts, and who are not called upon to make analyses of milk, inasmuch as the same methods which are applicable to milk are also applicable to other things.

The first problem which the author appears to have set himself in connection with the subject in hand was to get hold of a first-rate quantitative datum, which is easily attainable, and, at the same time, available for the purpose in view.

Such a datum, possessing these requisites in an eminent degree, was found in the total solids of milk. With the modifications made by Mr. Wanklyn this datum is rendered first-rate in a quantitative sense, inasmuch as the taking of milk-solids is made to rival the estimation of sulphuric acid or chlorine in accuracy. It is easily attainable, for the ordinary medical practitioner may be readily taught to make these estimations of milk-solids. And when obtained it is *available* for the purpose in view, since a knowledge of the yield of milk-solids alone—not supplemented with anything else—was enough to convict half of the milk-supply to London of being watered.

The determination of milk-solids with accuracy and ease forms the basis of Mr. Wanklyn's method of analysing milk. Having done this, the next operation is the extraction of the fat, which is effected by means of ether. Our readers will recollect a little note on this operation in the last No. of the CHEMICAL NEWS (Vol. xxix., p. 3).

Having ascertained these two facts, viz., how much total solids and how much fat, the task of the milk analyst is usually accomplished, for by help of these two data he is in a position to pronounce upon skimming and watering, and these are the usual forms of malpractice in the milk trade. Persons who have not looked into the question will be surprised to find how very constant is the composition of milk; and, from this treatise, it appears that there is an exceedingly constant factor in milk. This factor is the "solids not fat." It further appears that the ratio of "solids not fat" to the water naturally present is the same in whole milk, cream, and skimmed milk. The book ends with Chapter xv., entitled, "Poisonous Milk and Milk Panics." In this chapter it is set forth that the recent "frightful outbreak of typhoid fever in Marylebone," as it was called by the newspapers, was not in reality an outbreak of typhoid fever at all, but an outburst of panic, and, in point of fact, a doctor's panic.

Oscillation's Regulator. Von ROBERT RUNGVIST, Ingenieur in Stockholm.

THIS pamphlet gives a description of the principles, con-

struction, and uses of a patent machine for regulating oscillation. It is particularly recommended for marine engines, for regulating water-wheels, and for turning- and sewing-machines which are driven by steam, as also for telegraphic apparatus. This invention appears to have gained very favourable notice at the Vienna Exhibition.

CORRESPONDENCE.

ATOMS.

To the Editor of the Chemical News.

SIR,—In reference to "Atom's" last letter, I may remark that my reason for applying the term *Greatest Common Divisor System* to one of the modern views of chemistry which co-ordinates the known facts and expresses them symbolically without assuming anything whatever as to the nature of matter, is that this system is founded on the ascription to each element of a numerical value which is the greatest common measure of the different weights of that element obtainable from a constant volume (under constant circumstances) of all its gaseous compounds severally: for a development of this, *vide* CHEMICAL NEWS, vol. xxviii., p. 25. Probably "Atom" would call this number an *Atomic* number, as it represents a certain weight and a certain volume entering into combination in every instance; but the ideas connoted by this use of the term *atom* are not the same as those referred to by Leucippus, Dalton, and the modern physicists; and hence this use is apt to lead to confusion of ideas.

The President of the Chemical Society may safely be trusted to defend his own phraseology in case of need: I understand the paragraph referred to, quoted from his article on "Atomic Weights," as indicating a two-fold and partly contradictory use of the term *atom*; the one "materialistic" sense *explaining* the occurrence of proportional numbers by means of a special hypothesis, viz., that ultimate material particles of various kinds exist having such and such relative weights; the other, or "abstract" sense having no necessary reference either to this hypothesis or any other, but simply indicating the bare fact that proportional numbers exist without offering any *raison d'être* for their occurrence.

As a matter of fact, I have no doubt whatever that the use of the term *atom* in senses connoting entirely different ideas is productive of great perplexity and confusion of thought not only in chemical tyros, but in students of a far older growth; but even if this difficulty did not exist, or were ameliorated by careful explanation, it does not seem either philosophical or desirable to employ words in senses which lead to contradictory and diametrically opposed statements in the various manuals of chemistry and scientific papers.—I am, &c.,

C. R. A. WRIGHT, D.Sc.

St. Mary's Hospital, Paddington, W.,
Dec. 30, 1873.

ON THE ADJUSTMENT OF VOLUMETRIC SOLUTIONS.

To the Editor of the Chemical News.

SIR,—In a former communication I indicated a simple means of adjusting volumetric solutions without the trouble of measuring the liquid litre by litre, and I am glad to find that the method, which affords much facility where large quantities have to be made at a time, has been appreciated by many of my friends among your readers. I therefore think it worth while to correct a slight cause of inexactitude which occurs in my former communication.

I ought to have added a method of compensation for the very slight error caused by the withdrawal of the

second trial test. To be quite correct one must proceed as follows:—

Suppose it is required to make a test-solution of chloride of sodium capable of precipitating exactly 1 gm. of pure silver for each 100 c.c. of solution, and that it be requisite, as often happens in an assay office, to make a considerable volume of solution at once. The containing reservoir—be it a copper vessel, carboy, or what not—is well cleaned out and drained dry. I now take a clear filtered and saturated solution of common salt, and add it to some water placed in the reservoir; and let us suppose that, on taking a trial sample, I find the salt solution so produced to be too strong. Suppose that we find, on experiment, that 80 c.c. of the solution precipitate exactly 1 gm. of silver. It is obvious that, to bring this solution to the correct strength, it wants a further addition of 25 per cent of its volume—250 c.c. per litre. I now proceed to add a known volume of water, say 1 litre, having previously withdrawn a small sample, say 200 or 300 c.c., from the liquid in the reservoir. This sample I set aside for my future correction to be made. Suppose I find that now 81.25 c.c. of solution precipitate exactly 1 gm. of pure silver. The addition of the water has then made a difference of 1.25 per cent, or 12.5 c.c. per litre; if then we divide the quantity added (in the present case 1 litre = 1000 c.c. of water) by 125, we obtain the number of litres the vessel contained before the second example was taken, viz., in this case, 80 litres. Now, by the first experiment it was found that 250 c.c. per litre, = 25 per cent, were required to adjust the strength of the solution, and we have just added 1 litre. There then remains to be added $(80 \times 0.25) = 1$ litre, i.e., 19 litres.

I now count how many cubic centimetres of liquid I withdraw for the second test-trial. Suppose it in this case to have been 200 c.c. I then take the portion of the first solution which I set aside, and add to it water in the proportion of 12.5 c.c. to a litre. Supposing I had set aside 300 c.c., the quantity to be added would be 3.75 c.c. I measure off 200 c.c., = the portion withdrawn for the second test-trial, and add this to the liquid in the reservoir, when, providing the measurements and titrations have been exactly performed, the solution is brought to mathematical exactitude. Besides this, I become further aware that I have 100 litres of solution in my reservoir.

Had the solution been too weak instead of too strong I could have calculated, in a similar manner, the quantity of salt water that would have had to be added to increase the strength to the right point. The same method serves for every kind of volumetric liquid that can be made.

While on the subject of volumetric testing, I may mention a method used in our new process for refining sugar with tribasic phosphate of ammonia and hydrate of baryta. In this process it becomes necessary to ascertain with accuracy the respective quantities of sulphuric acid and lime which a given syrup contains.

A solution of soap test-liquor is prepared with oleate of potassium, and its strength is adjusted on a solution of barium nitrate containing 13.05 grms. of that salt per litre: 1 c.c. of such a soap test-solution is equivalent to 0.0028 gm. of calcium oxide. We prefer the barium nitrate for adjusting the soap test-liquor, on account of its being so easily obtainable in a state of purity and anhydrous, and also on account of the high equivalent barium salts possess as compared with calcium salts.

First of all we estimate the amount of calcium oxide in a sample of the syrup with our soap test-solution in the usual manner, and note the amount, and then, having added to another sample of the same syrup a measured volume of barium nitrate, more than sufficient to precipitate all the sulphuric acid, we again test the mixture with our soap solution, and were there no sulphuric acid present we should this time be obliged to add as much soap-liquor as we added of barium solution, together with the quantity of soap solution corresponding to the calcium oxide originally in the syrup: as, however, there always is some sulphuric acid in all raw sugar, this

throws down and renders inert its equivalent of barium, reducing proportionately the quantity of soap solution we have to employ. By estimating the amount of this diminution of the soap solution required, and counting for each centimetre cube 0.004 gm. of anhydrous sulphuric acid, we obtain the proportion of this latter which the syrup contains, as well as the quantity of calcium oxide already estimated.

Example.—Suppose that a sample, 300 c.c., of a syrup require 7 c.c. of soap solution to produce frothing = 0.0196 gm. oxide of calcium, = 0.098 gm. per litre. We now add 10 c.c. of barium solution, this being found to be more than what is requisite to precipitate all the sulphuric acid and leave a little barium in excess. Were there no sulphuric acid present we should be obliged to add 17 c.c. of soap solution, in order to produce frothing. As it is, however, suppose we find that only 9.5 c.c. is required, then 6.5 c.c. is the quantity of barium nitrate solution which has become sulphate, and—

$$6.5 \times 0.004 = 0.026.$$

By the first experiment on the syrup with the soap test-solution we found 0.098 gm. oxide of calcium per litre, and, on the other hand, we find 0.0260 of sulphuric acid capable of combining with 0.0182 of oxide of calcium.

The syrup then contains 0.0442 gm. sulphate of calcium per 200 c.c., = 0.2210 gm. sulphate of calcium per litre, and 0.0798 gm. oxide of calcium per litre.

This mode of estimating both calcium oxide and sulphuric acid, when in solution together, is applicable in many cases; and not necessitating filtrations and boiling, it forms, in many instances, a most convenient mode of estimating sulphuric acid in combination.—I am, &c.,

F. MAXWELL LYTE.

Laboratoire, 6, Cité de Retiro, Paris,
December 21, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, November 24, 1873.

On some Phenomena of Illumination.—M. Lallemand.—All the effects of illumination in transparent bodies traversed by natural or polarised light may be explained by supposing that the vibratory movement of the ether, penetrating the medium, experiences a resistance in virtue of which the vibrations are propagated laterally in such a way that, in a direction somewhat oblique to the incident ray, the movement of the ether particle represents the projection of that animating the ether in the passage of the luminous bundle; and, on the other hand, that the molecules of the medium, absorbing a part of the *vis viva* of the ether, vibrate in their turn, and propagate, in the etherised fluid, the complex vibrations forming natural light. Illumination, then, is the result of two superposed effects, and the emanating light is formed of two kinds of rays—some, which are always of the same colour as the incident rays, are partly or completely polarised, according as the incident bundle is natural or polarised; others, whose refrangibility is often inferior to that of the exciting rays, have the properties of natural light, and produce *fluorescence*. This fluorescence is a general property of transparent bodies. Using the purest liquids (as those from condensation of sulphurous acid gas, cyanogen, &c.), the illumination is not extinguished when one looks in a direction normal to the bundle and to the plane of polarisation of the incident light, or, if natural light is used, and it is observed through a bi-prism, one of the two images

never quite disappears. Among crystallised substances, quartz and rock-salt do not show the least trace of fluorescence, and they are distinctly illuminated. The author polarises a bundle of solar rays with a Foucault prism, and concentrates it with a lens of quartz cut parallel to the axis. The principal sections of the polariser and lens are made to coincide. If the bundle thus concentrated traverses the quartz, either in the state of the ordinary ray or of the extraordinary, one observes in the plane of polarisation a distinct white trace, which is quite extinguished with a Nicol. Looking in a direction normal to the plane of polarisation, the illumination is *nil*; and there is not the least trace of fluorescence. When the ray traverses the quartz in the direction of the optic axis, the dispersion of the plane of polarisation has for result an equal illumination about the ray, and the polarisation is complete only in a direction normal to the bundle. There is no chromatic illumination, only a uniform grey tint. Pure rock-salt, as well as quartz, may be thus illuminated, and is not fluorescent. It is different with Iceland spar; all the specimens examined were illuminated orange-red, but the illumination is the same in the plane of polarisation and at right angles to this plane. It is not extinguished by a Nicol, when the emergent rays are superposed. The orange-red is due to fluorescence, and the polarised illumination is not appreciable. The fluorescence due to the ordinary ray appears of a deeper red than that of the extraordinary. Colourless fluor-spar unites the two distinct properties of quartz and (Iceland) spar in greater intensity; it gives a white illumination, very vivid in the plane of polarisation, and a violet-indigo fluorescence in the perpendicular direction. These three crystallised substances—quartz, spar, and fluorine—represent, from the illumination-point of view, three types, to which all transparent bodies may be referred. To cite an example not previously remarked, pure naphthalin, dissolved in alcohol or rectified essence of petroleum, has a quinic fluorescence of bright indigo-blue. Curious effects are obtained with prisms of hardened glass; the thread of polarised light traversing them gives a luminous trace, which is white and partly polarised at certain points, while at other points it is natural and coloured yellowish-green or bluish-green according to the fluorescence of the colours used, these effects depending on the double refraction of the luminous ray and the direction of the plane of polarisation of the illuminating bundle. The author adds some remarks on the photospheric experiments by means of which he measured the proportion of polarised light in rays emitted by a liquid illuminated by a bundle of rays of natural light.

Observations on the Increase of Volume of Water under 4° .—(*Apropos* of M. Mondesir's note).—M. Hement.—Dilatation is, in general, a phenomenon in which the molecules of a body remove from each other without altering its form, these molecules still having the same relative positions. The expansion of water under 4° presents nothing analogous. The molecules continue to approach under the influence of reduced temperature (this must be a general effect); the pores constantly diminish, but intervals of another nature are produced in the water from 4° to zero. Suppose a vessel in which pins are arranged in layers, so that there is the least possible empty space. If the vessel is inverted, and the pins are spread out, they are entangled with each other in all directions, and may occupy a greater volume than that of the vessel. We may compare the crystalline needles of ice to these mixed pins; each needle is, so to speak, a brochette of molecules, in which the molecules are nearer to each other than they were before crystallisation. It may be said that, crystallisation taking place only at zero, it is only then that this state of things can occur, whereas the augmentation commences from zero. But it is at 4° the molecules commence to arrange themselves in suitable order; the change of state is not an instantaneous phenomenon, but prepared in advance.

Letter from M. Poëy (to M. Elie de Beaumont) on the Relation between Solar Spots and Hurricanes of the Antilles, the North Atlantic, and the Southern Indian Ocean.—The writer furnishes a table of 357 hurricanes (between 1750 and 1873) originating in the northern intertropical region, in the neighborhood of Bermudas and the Cape Verde Islands, and extending to Europe. *En résumé*, in the last century and a quarter we have twelve maximum periods of hurricanes, of which ten correspond to maximum periods of solar spots; and eleven periods of minima, of which five correspond, similarly, to minima of spots. As to absolute intensity of hurricanes, one also finds an agreement with the solar spots. It is worthy of remark that the hurricanes traversing the island of Cuba in October are generally the most intense, and reach Western Europe most directly; the others are dissipated towards the polar regions. The memorable hurricanes of 1751, 1780, and 1837 all occurred in October. Now the mensual distribution of solar spots, according to M. Wolf, presents its first maximum precisely in this month, and a second maximum in December and January, corresponding to the maximum of winter tempests in high latitudes. The writer further finds the same agreement as regards the periods of 55 or 56 years pointed out by MM. Fritz and Wolf, the last maxima having been in 1837 and 1779. 1837 shows thirteen cases of hurricanes (the *maximum maximorum* for a single year), and twenty-nine cases in 1837 to 1839. 1780 shows seven cases, and there were twelve in 1779 to 1781. The years 1780 and 1837 are also maxima in terrestrial magnetism and polar auroras. The writer next examines the unexpected exception of the sun-spot maximum of 1860, where the table does not present any case of hurricane. He has recourse to a recent discovery, by MM. De la Rue, Stewart, and Loewy, viz., that when the photosphere is subject to great perturbations, the spots change alternately from the northern to the southern hemisphere, and *vice versa*, in the mean period of 25.2 days. May we conclude, he asks, from the fact that the solar perturbation of 1860 was principally limited to the austral hemisphere, that this circumstance may have had some influence on the rarity, or even absence, of hurricanes in the intertropical region of our hemisphere, while, in the same region of the austral hemisphere and of our antipodes, M. Meldrum has ascertained thirteen cases of storms in that year, and for the preceding year the high maximum of fifteen cases? It remains for enquiry whether other solar perturbations, as those in 1869 and 1872, in which years there were no hurricanes, were not also in the austral hemisphere. If this hypothesis should be confirmed, the rarity of hurricanes in our intertropical region might reveal the existence of solar perturbations, the transport of spots to the austral hemisphere, and the abundance of hurricanes in the southern Indian ocean. P. Secchi has found meridians which distinctly give maxima, and others minima, of protuberances.

Observations Apropos of M. Reye's Note on the Analogies between Solar Spots and the Whirlwinds of our Atmosphere.—M. Marié Davy.—The author somewhat defines his opinions on the cyclonic movements in the sun, and considers that M. Reye's objections are not sufficient to invalidate M. Faye's theory of the spots.

Note on Terrestrial Cyclones and Solar Cyclones.—M. de Parville.—The two contrary opinions of M. Faye and M. Reye appear to the author too absolute. Each cyclone shows separately, by its direction of rotation, whether it is ascending or descending. If its direction is opposite (inverse) to the hands of a watch (which occurs in the northern hemisphere), it is ascending; if the same, it is descending. The direction of rotation is determined by the ascent or descent. Bandrols do not give a sure index, whether the vertical component of the wind is ascending; but the barometer does, presenting a fall in the ascending current and a rise in the descending. Thus, the direction of rotation of cyclones, and the fall of the

barometer before complete generation of the meteor, seem to furnish two decisive arguments against the theory of descending movements of equatorial cyclones with inverse movement maintained by M. Faye. As to waterspouts, M. Faye argued that, if the alimentation were from below, the meteor would lose its force as its lower end neared the earth, which is contrary to fact; but M. de Parville considers that the very narrowing of the orifice of supply must increase the velocity of flow. M. Faye attributes whirlwinds to differences of velocity in two neighbouring parallels; M. de Parville thinks they arise from the rupture of equilibrium in the vertical, determining affluxes with inverse velocities. Similarly in the sun, especially where there might be an attraction of gas from periphery to centre to fill a vacuum produced by an ascending current, a whirlwind with inverse rotation would be generated. A divergent gaseous mass would generate a whirlwind with direct rotation. M. Faye objects that, if the spots were produced by convergent affluxes, there would be attraction of the gas of the solar equator to the middle parallels, and deviation in the direction of rotation; now the angular velocity of rotation is maximum at the equator. It is replied that the rotation is only measured by the movement of the spots; the variation of real velocities in the different parallels escapes observation, but the angular velocities ought to diminish for the spots, according to the law of rotation formulated by Carrington and others. It has not been sufficiently considered that, whatever the velocity of gases at the equator, every afflux rising towards the middle parallels diverges in the direction of rotation; every descending afflux, on the other hand, diverges in the opposite direction. The *vis viva* of these affluxes is employed almost wholly in turning the mass of intermediate gas, which continues to follow its course with a velocity nearly equal to that of the parallel in which it is. The analogy of trade-wind circulations is thus not inapplicable to the sun. The temperature of the air being high over continents, the rupture of equilibrium and the descending flow will take place principally on the sea. About this axis in the middle of the ocean, there will be a general circulation in our atmosphere from left to right, and this agrees with observation. Again, the air is forced from its maximum of pressure towards the poles, and generates in its ascending movement a south-west wind with vertical component. The south-west wind in our latitudes is rising, instead of descending, as meteorologists maintain; otherwise the barometer would rise instead of falling. This ascending afflux produces a new gyratory movement with inverse rotation, but not so well determined as the preceding, because the axis is incessantly displaced. This represents the south-west wind of our countries, and the north-west of the American coast. The afflux of ascending air from high regions may produce whirlwinds at the limits of the atmosphere, but with a direction of rotation opposite to that of the whirlwinds of maximum pressure.

Apparent Orbit and Period of Rotation of the Double Star ξ of the Great Bear.—M. Flammarion.

Discharge of Electrified Conductors.—M. Montier.—The author offers some mathematical considerations, from which may be demonstrated a theorem established by Gauss and Lionville.—When conductors contain respectively equal quantities of the two fluids, all these conductors are in the natural state. The potential is *nil*; consequently the exterior discharge of the system cannot produce any work.

Variable State of Voltaic Currents.—(Reply to M. Cazin).—M. Blaserna.

Application of Phosphate of Ammonia and Baryta in the Purification of Saccharine Products.—M. P. Lagrange.—The modes of purification at present employed in sugar-works are almost all based upon the action of lime and its subsequent elimination by means of carbonic acid. They all leave in the saccharine products a certain proportion of organic matters and of mineral

salts which, to a certain extent, prevent the crystallisation of the sugar. These bodies are the cause of the formation of treacle and of the loss of sugar in residues. The author proposes to eliminate the organic salts of lime, the potassa and soda salts of certain vegetable acids, and the alkaline sulphates by combining the action of baryta and of phosphate of ammonia. In operating upon syrups it is necessary to keep them alkaline or the crystalline sugar becomes transformed into glucose. At present sugars and syrups are kept alkaline by lime, which not only exists in a soluble state in these products, but combines with vegetable acids to form very stable lime salts. These salts are not decomposed by carbonic acid, which, however, removes lime dissolved in the sugar. These organic lime-salts occasion much trouble in every stage of the sugar manufacture. Animal charcoal, in the proportion in which it is employed, does not effect their absorption. The author uses for their decomposition basic phosphate of ammonia. Phosphate of lime is formed and ammonia set free. The juices and syrups thus freed from lime would quickly become neutral and acid. Baryta or sucrate of baryta is therefore used to complete their purification. The baryta has a twofold action. It decomposes the alkaline sulphates, forming sulphate of baryta, and also several organic salts of potassa and soda, giving rise to compounds insoluble in an alkaline medium. This liberation of potassa and soda not only favours the insolubility of the organic salts of baryta, but serves to maintain the alkalinity of the syrups freed from lime. In the extraction of sugar, syrups are generally treated at 20° Baumé, having generally undergone the carbonic-calcic treatment. The product is placed in a steam-jacketted boiler and phosphate of ammonia is introduced equivalent to the lime, the quantity of which must be previously determined, so that not more than 1-10th per cent may be left in the syrup, an amount which the animal charcoal is able to absorb. Baryta is then added in proportion to the alkaline sulphates and the organic matters, of which not more than 1 per cent should be allowed to remain. The whole is raised to a boil and thrown upon Tayler's filters. The purified syrup as it drains from these falls upon granulated bone-black, leaving in the filters a precipitate valuable as manure. In refining, the purification is made in the boiler in which the raw sugar is melted. The finely-ground bone-black and the blood are suppressed and phosphate of ammonia, previously dissolved, and equivalent to the lime, takes their place. Then a solution of baryta is added in proportion to the alkaline sulphates and organic matters in the sugar, leaving the syrups faintly alkaline.

Zeitschrift für Analytische Chemie, von Dr. C. R. Fresenius, Zwölfter Jahrgang, Zweiter Heft, 1873.

Presence of Quercetin and Quercitrin in Catechu and Sumac.—Julius Löwe.—Both these bodies appear, according to the author's experiments, to be present in various kinds of catechu and sumac, though in very small quantities.

Tannin of Sumac.—Julius Löwe.—The author previously expressed the opinion that (*Zeitschrift für Analytische Chemie*, vol. xi., p. 365) the tannin of sumac is distinct from that of nut-galls. After a careful examination he now pronounces them identical.

Determination of Potassa.—Dr. F. Mohr.—The platinochloride of potassium can only be weighed as such upon the filter, an equal degree of exsiccation being, of course, necessary. Such weighings upon a counterpoised filter are always unsatisfactory, whence it is preferable, whenever possible, to burn the filter. The smaller the amount of the platinum salt, the greater the errors are possible. The author therefore endeavours to determine the amount of potassa by titrating some substance contained in the salt; as such, he naturally selects the chlorine. The platinochloride is only partially decom-

posed by heat, a part of the chloride of platinum being apt to remain untouched; on the other hand, the salt is readily decomposed if heated to fusion in a platinum crucible with twice its weight of oxalate of soda. After lixiviation, the chlorine can easily be determined by a decinormal silver solution.

Volumetric Analysis of Free Oxygen.—Dr. F. Mohr.—An examination of Schützenberger's method with the hydrosulphite of soda. The author recommends a solution of ferric chloride, or of iron-ammonia alum, with sulphocyanide of potassium as indicator, for standardising the hydrosulphite solution. He covers the reducing liquid in the burette with a layer of benzol of from 5 to 10 m.m. in depth, and reads off at the line of separation of the two liquids, which is almost horizontal, and can be read very distinctly. Dr. Mohr remarks that the entire process involves a certain *petitio principii*—the assumption that the reducing liquid acts in the same manner upon the oxygen of ferric oxide as it does upon free oxygen. The oxidisability of hydrosulphurous acid is so great that even the height from which the drops fall, and the size of the surface, have a perceptible influence.

Analysis of Galena.—Dr. F. Mohr.—Storer's process consists in decomposing the galena in contact with zinc, sulphuretted hydrogen being given off, and metallic lead set at liberty. Hence it might seem that contact with zinc was necessary, and that the disengagement of sulphuretted hydrogen was a consequence of its presence. This is not the case. Pure finely-ground galena is completely decomposed by common hydrochloric acid, with development of sulphuretted hydrogen and formation of chloride of lead. The action, however, is soon stopped by the precipitation of chloride of lead upon the galena, and by the saturation of the acid with chloride of lead. The action of the zinc removes these inconveniences. It is generally supposed that the sulphide of lead, as precipitated by sulphuretted hydrogen, is insoluble in acid liquids; this is incorrect. Recently precipitated and washed sulphide of lead is instantly attacked by hydrochloric acid, even in the cold, and converted into chloride of lead, with evolution of sulphuretted hydrogen. It is also known that in very acid liquids—in sulphuric and hydrochloric acids—lead cannot be detected by means of sulphuretted hydrogen. Galena can be completely extracted from mixed ores by hydrochloric acid, and the lead can be deposited from the solution. Copper pyrites yields to boiling hydrochloric acid not a trace of copper, but only a small quantity of iron. Zinc, iron, and manganese, if present, are not thrown down by zinc from acid solutions. It is possible to dissolve galena alone, and to throw down its lead; and Storer's condition, that the galena must contain no other heavy metal, is not essential, with the exception, perhaps, of antimony. The weighing of the lead as metal is practicable, but does not give comparable results. It is most accurately determined as sulphate. With whatever foreign metals (except antimony) galena is mixed in the gangue, the separation of the lead in the state of sulphate can always be effected in the following manner:—2 grms. of finely powdered galena are weighed off, and placed in a small porcelain pan furnished with a handle. It is covered with ordinary pure hydrochloric acid, covered with a convex glass, heated to set free sulphuretted hydrogen, and finally boiled. A large quantity of chloride of lead separates out. When the acid is saturated with chloride of lead, zinc is added in the form of a small ball. Brisk evolution of hydrogen gas commences, and lead is thrown down upon the zinc. By the aid of a gentle heat, fresh quantities of chloride of lead are dissolved and decomposed, until the liquid appears clear and colourless, and the evolution of sulphuretted hydrogen ceases. The liquid is poured off, and the lead thoroughly washed with pure water in the capsule. The decantation is safe and easy, on account of the high specific gravity of the lead. Dilute nitric acid is poured upon the lead while still moist, and heat is applied till the metal is dissolved, when nitrate

of lead is separated if the amount of water present is insufficient. The nitrate of lead is dissolved by water and the application of heat, the liquid is filtered, and the filter washed with hot water. In the filtrate, the lead is thrown down by the addition of distilled sulphuric acid in large excess, and heated for a time, when the sulphate of lead is deposited in a dense form. When cold, the whole is filtered, the precipitate washed with dilute sulphuric acid and finally with a little alcohol, dried, and the weight of the sulphate of lead determined after incineration of the filter. The filtrate when saturated with ammonia shows scarcely a trace of brown colouration with sulphuretted hydrogen.

Swedish Filter-Paper.—Dr. F. Mohr.—The author shows that Swedish filter-paper is now undeserving of its high traditional reputation, and that it contains soluble alumina.

Arrangement for Preventing the Escape of Offensive Gases in Laboratories.—Dr. F. Mohr.—The author passes the gases through a two-necked Wolff's bottle containing milk-of-lime, and allows the residue to escape through a funnel filled with fragments of lightly-burnt wood-charcoal the size of a nut.

Correction of the Weight of Platinum Crucibles.—Dr. F. Mohr.—Instructions for the use of a counterpoise, instead of weighing the empty crucible after use.

Experiences in Chemical Jurisprudence.—H. Struve.—The author discusses minutely the methods for detecting nicotin and colchicin in cases of poisoning, also the reactions of morphia, piperin, brucin, strychnin, and daturin.

Behaviour of Chloride of Silver with Concentrated Sulphuric Acid and with Solution of Perchloride of Iron.—A. Sauer.—It is commonly stated that chloride of silver is not attacked at all, or but very slightly, by concentrated sulphuric acid. This is incorrect. If chloride of silver, either recently precipitated and washed, or crystallised, or fused, is heated for some time with concentrated sulphuric acid in a covered porcelain capsule, the chloride of silver is decomposed and dissolved, with escape of hydrochloric acid. Chloride of silver is also soluble in solutions of perchloride of iron, a circumstance which should not be lost sight of in determinations of silver.

A New Application of Kempf's Washing-Bottle.—A. Sauer.—The author applies this bottle in preserving solutions of protochloride of tin from contact with the air.

Appendix to the Paper "On a Method of Determining Sulphur of General Applicability."—A. Sauer.—The author furnishes the results of analysis in proof of the value of his method. He adds the caution that the sulphur in crude iron cannot be determined on this principle. In determining the sulphur in coal, lignite, &c., he employs not carbonic acid, but common air; in case of bisulphide of carbon and coal-gas it is necessary to use carbonic acid. In order to absorb the vapours of bromine that pass over, and for the certain absorption of the sulphurous acid, the author employs a second ball, U-tube, containing very dilute hydrochloric acid. This readily dissolves the bromine that passes over, and if no sulphuric acid is present in the last U-tube, the bromo-hydrochloric acid may be used again.

Apparatus for the Quantitative Determination of Fats.—E. Simon.—This paper would not be intelligible without the accompanying illustration.

Improved Apparatus for Quantitative Analysis.—A. Gawalowski.—The author describes an apparatus for concentrating filtrates, &c., without delay and without loss, and a syphon for drawing off liquids that emit acid or ammoniacal vapours, &c. The descriptions could not be distinctly understood without the illustrations.

Determination of Chlorine in Presence of Sulphurous Acid.—R. Messell.—In volumetric determinations of the chlorine or hydrochloric acid in the chimney-

gases of soda-works, the author found that chlorine cannot be determined when in presence of sulphurous acid by Mohr's method, *i.e.*, in a neutral solution with chromate of potassa for indicator. If only small quantities of sulphurous acid exist in solution, a red colouration of chromate of silver appears, which, however, gradually disappears again. The final reaction does not appear until all the sulphurous acid has been precipitated as sulphite of silver.

Determination of the Granular Density of Gunpowder.—Dr. E. Luck.—A lengthy paper, rather of a physical than chemical nature.

Determination of Chrome in Chrome Iron.—F. C. Phillips.—According to A. Mitscherlich, most obstinate minerals can be decomposed and dissolved by heating them with sulphuric acid in closed glass tubes. In case of chrome-iron it was found that sulphuric acid of the specific gravity of 1.34 at temperatures between 250° to 300° C., gave the best results; 8 c.c. being sufficient for $\frac{1}{2}$ grm. of the ore. If a solution of a salt of chromic oxide is mixed with carbonate of soda in excess, and bromine-water is then added drop by drop, with constant stirring, the chrome dissolves as chromate of soda. A number of experiments proved that the separation of chromium in this manner from zinc, manganese, iron, and alumina, is complete. Alumina, however, is less easily treated than the others. The solution must be much diluted, and must contain only a slight excess of carbonate of soda. Heat is not applied until *after* the addition of bromine.

Chemico-Technological Gas Analysis.—M. Winkler.—The author treats of the determination of oxygen, nitric oxide and nitrous acid, chlorine, hydrochloric acid, ammonia, sulphuretted hydrogen, and carbonic oxide.

Pressure Regulator, for Determining Boiling Points.—Lothar Meyer.—This paper could not be understood without the accompanying illustration.

New Exsiccator.—G. J. A. Artope.—The same remark may apply here as in case of the last paper.

Improved Caoutchouc Blowpipe Bellows.—Armin Junge and K. Mitzopulos.

Determination of Melting Points.—E. Kopp.—The author recommends a mercury bath in preference to one of sulphuric acid or of oil.

Application of Sulphide of Sodium as a Blowpipe Reagent.—M. Jean.—The substance to be examined is fused with borax in the reducing flame, a polysulphide of sodium is added, and the whole re-heated in the reducing flame, when according to the metals present either clear sulpho-salts or opaque masses of various colours are obtained. According to the author, iron, lead, bismuth, nickel, cobalt, palladium, thallium, silver, copper, uranium, give a brown opaque mass; zinc an opaque white; cadmium a mass yellow when cold, but scarlet when heated; manganese a dirty chesnut brown; gold and platina a clear, translucent, mahogany-coloured; tin a translucent yellowish brown; chromium a green arsenic, and antimony, clear and colourless; vanadium and iridium blood-red.

Cement for Corks.—Otto Facilides.—A syrupy solution of shellac in benzol and one of caoutchouc in the same solvent are prepared separately and mixed together. The cement is said to resist chlorine.

Mixter's Process for the Determination of Sulphur.—H. Fresenius.—This paper would not be intelligible without the accompanying illustration.

Detection of Iodine.—Henry and Tilden recommend solution of permanganate for the liberation of iodine, with a view to its subsequent detection by means of starch. The reaction is, however, less sensitive than that of hyponitric acid.

Preparation of Chemically Pure Grape Sugar.—H. Schwartz.—If cane-sugar is dissolved in alcohol of 80

per cent, to which a little hydrochloric acid has been added, after some time grape-sugar separates out in a state of chemical purity,

Determination of Nitrogen in Bodies rich in that Element.—M. Maercker.—The author has compared the results of Will-Varrentrapp's method with that of Dumas and finds that the two agree when the ammonia obtained in the former is determined by means of chloride of platinum. O. Nasse washed out the bulb-tube into a capsule, evaporates to dryness, and titrates the residual chloride of ammonium with nitrate of silver. S. W. Johnson recommends in place of soda-lime a mixture of dry carbonate or sulphate of soda and hydrate of lime.

Quantitative Determination of Asparagin.—R. Sachsee.—The author founds his process upon Knops's method.

Determination of Moisture in Bone-Black.—J. Walz.—The application of a temperature of 121° for four hours, or a period of twenty-four hours in the exsiccator is sufficient to drive off all the moisture.

Test for Balsam of Peru.—G. H. Hager.—The author recommends that 2 to 3 c.c. of the sample should be shaken up with 6 to 8 c.c. petroleum ether and allowed to stand, when it is separated into a dark brown mass, and a colourless stratum, which can be decanted off. If the sample is falsified this liquid has a decided yellow or brownish colour or opaque, or the dark residue is mobile, and some of it passes over with the clear liquid, or it coagulates speedily after removal of the upper layer, or it does not adhere to the sides of the cylinder.

Detection of Fatty Oils in Ethereal Oils.—F. Rhien.—A flask containing $\frac{1}{2}$ litre is filled to the half with distilled water, and is connected by 2 tubes, bent at right-angles and united with caoutchouc, to a smaller flask of 200 c.c. capacity, in such a manner that the longer leg of the tube reaches to the bottom of the smaller flask. Into the latter pour about 100 c.c. of distilled water and from 1 to 10 or 15 c.c. of the sample of oil. The small flask is then connected with a Leibig's condenser. A cylinder graduated in tenths of a c.c. is placed to receive the distillate provided with a bent lateral tube to pour away the water which passes over with the oil. This cylinder is filled to overflowing with distilled water. Everything being thus arranged, the water in the large flask is brought to a boil, which is kept up till all the essential oil is carried off by the current of steam.

There are also a number of notes on zoo-chemical analyses, such as a method for detecting nitrites in the saliva, by means of a mixture of starch-paste and iodide of cadmium; a process for determining the absolute amount of the blood; the detection of cystin in urinary calculi; the determination of urea, by means of Millon's reagent; the determination of sugar in diabetic urine; and the analysis of human milk.

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THE CHEMICAL NEWS.

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RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 17).

I WOULD here ask whether chemists in their analytic analyses sufficiently allow for barometric variation. The temperature at the time of weighing is generally recorded: chemists have known the influence of pressure on the boiling-point, and its effect upon gases, yet they appear to neglect reference to the barometer when weighing solids, forgetting that they are weighing in a gas which itself possesses weight. Weighings are repeated after some operation, such as expelling moisture, at intervals sufficiently long to admit of considerable variation in atmospheric pressure, and the increase or decrease of a few milligrammes in weight is considered to determine the gain or loss of certain constituents. It remains to be seen whether a neglect of variation in barometric pressure would not account for these minute differences.

An approximation to the true weight of bodies, that is, their weight *in vacuo*, may be obtained by the following formula, when their specific gravity and weight in air of 760 m.m. pressure of mercury at 0° C. is known.

Let W = weight in grains; then the weight of air displaced is—

$$\frac{W}{\text{sp. gr.}} \times 0.00122.$$

This weight *plus* the value of the weights *in vacuo* balancing the substance is its true weight *in vacuo*.

Let the weight of 800 grains of water in 200 grains of glass be required from two assistants, the one weighing against brass, the other against platinum weights, neglecting (1) the weight of air displaced and (2) its variation in weight from barometric disturbances.

(1). The true value of 800 grains of water weighed in air (bar 760 m.m. 0° C.) = 800.976 grains.

That of 200 grains of glass	=	200.0976	grs.
Weight of air displaced by water	=	0.976	"
" " " glass	=	0.0976	"

A brass weight of 1000 grains in use in my laboratory displaces 0.1462 gr. of air; a 1000-grs. platinum weight, 0.058271 gr. of air.

The weight of glass and water	=	1000.0000	grs.
" " air displaced by them	=	1.9736	"

Weight of glass and water ..	=	1001.9736	
------------------------------	---	-----------	--

Glass and water	=	1001.9736	grs.
Less air displaced by weight			
(brass)	=	0.1462	"

1001.8274 grs. =

= the true value of the water and apparatus received from the assistant employing brass weights.

Glass and water	=	1001.973600	grs.
Less air displaced by weight			
(platinum)	=	2.058271	"

1001.915329 grs. =

= the true value of the water and glass received from the assistant employing platinum weights.

(2). In a note to the translation of Deschanel's

"Natural Philosophy,"* by Professor Everett, it is said, "In strictness the weight in grammes of a litre of air under the pressure of 760 m.m. of mercury is different in different localities, being proportional to the intensity of gravity—not because the force of gravity in the litre of air is different (for though this is true, it does not affect the numerical value of the weight when stated in grammes), but because the pressure of 760 millimetres of mercury varies as the intensity of gravity. So that more air is compressed into the space of a litre as gravity increases. The *weight in grammes* is another name for the *mass*. The force of gravity on a litre of air under the pressure of 760 m.m. is proportional to the square of the intensity of gravity. This is an excellent example of the ambiguity of the word *weight*, which sometimes denotes a mass, sometimes a force; and though the distinction is of no practical importance so long as we confine our attention to one locality, it cannot be neglected when different localities are compared." In one locality we have to deal with differences of air pressure alone. Assumed that we are weighing at Greenwich, where gravity is to that of Paris as 3457 to 3456, the weight of a litre of dry air at Paris being 1.293167 grm. at 0° C. at a barometric height of 760 m.m., the weight of a litre of air at Greenwich at the same barometric and thermometric heights will be 1.293561 grm. Knowing the weight of a litre of air at 760 m.m. barometric height, at a lower height of the mercurial column the weight will be proportionately less, the temperature being supposed constant; so that the weight of air displaced with the barometer at 740 m.m. by the glass apparatus and water will be 1.9216 grs., and at 715 m.m. 1.8890 grs. The brass weight will displace 0.1424 gr. of air at 740 m.m. and 0.1385 gr. at 715 m.m.; the platinum weight will displace 0.56737 gr. of air at 740 m.m., and 0.054666 gr. at 715 m.m. The assistant weighing with brass weights would give then—

Under 760 m.m. an error of 1.8276 grs.	} on the 1000.
" 740 " " 1.7792 "	
" 715 " " 1.7505 "	

The assistant weighing with platinum weights would give—

Under 760 m.m. an error of 1.915329 grs.	} on the 1000.
" 740 " " 1.864863 "	
" 715 " " 1.834334 "	

Proceed on another supposition. Let the apparatus be weighed on two days, the barometer readings being respectively 740 m.m. and 715 m.m. Weighed on, say, the first day at 715 m.m., on the second day there would be an apparent increase of nearly 0.029 gr.; and if weighed again on a third day at 760 m.m. an increase of 0.0771 gr., or against platinum weights nearly 0.081 gr.

Had a specifically lighter fluid than water been taken, or exceptional cases exemplified, it would have been possible to have largely increased these numbers; but they are a fair average of the errors unrecognised in ordinary manipulation.

To select another instance. In the determination of the amount of carbonic acid yielded by an organic body under combustion, the weight of the potash and bulbs is always sufficiently great to introduce an error arising from neglect of barometric variation. Thus, taking the potash and bulbs to weigh 600 grains, there would be displaced 0.336 gr. of air at 760 m.m. pressure, 0.327 gr. at 740 m.m., and 0.316 gr. at 715 m.m. Between 715 and 760 m.m. there is an increase of weight of 0.02 gr., or, supposing 3.5 grs. of the substance under analysis had been taken, an increase of nearly 0.6 per cent. Again, a chloride of calcium tube, weighing, with its contents, 350 grs., displaces 0.2135 gr. of air at 760 m.m. pressure. Between 715 and 760 m.m. there will be an increase of 0.0127 gr., or of 0.36 per cent. Thus, in the estimation of the carbonic acid and of the water yielded by the organic body, the total error introduced by barometric variation is

* A Paper read before the Royal Society June 20, 1872.

* Part I., p. 141.

nearly 1 per cent. I need not quote illustrations of the effect of such an error upon the formula deduced; it will perhaps account for the difference from theory often obtained in the results of carefully conducted analyses.

The preceding calculations show that a simple formula may be stated which shall include the corrections on a certain volume of air for pressure and for temperature. It is—

$$W = 1.293651 \text{ gm. } V \frac{1}{1 + 0.00367 T} \cdot \frac{P}{760},$$

where W is the weight in grammes of a volume (V) of air at a pressure P and temperature T, 0.00367 being the coefficient of the expansion of air. For accurate experiments, it will be necessary to substitute the weight of a litre of air in the locality of the laboratory for the coefficient of V. The formula, as it now stands, is calculated for the volume in litres; if a cubic centimetre be taken, the coefficient of V becomes 0.001293651; if a cubic decimetre, 0.01293651. For laboratory purposes, the ratio of the pressures might be tabulated; this is scarcely necessary, however, if the ratio 759 : 760 be taken = 0.9987 as sufficiently accurate, for a tabular difference of 0.0013 will enable the operator to speedily determine the ratio he requires.

In particularly describing the vacuum balance, I have one peculiarity to note in relation to the effect of heat in diminishing the weight of bodies. That a hot body should appear to be lighter than a cold one has been considered as arising from the film of air or aqueous vapour condensed upon or adhering to the surface of the colder body, or from the upward currents of air caused by the expansion of the atmosphere in the vicinity of the heated body. But neither hypothesis can be held when the variation of the force of gravitation occurs in a vacuum as perfect as the mercurial gauge will register, and under other conditions which I am now supplying, and which I purpose embodying in a paper to be submitted to the Royal Society during a subsequent session.

(To be continued).

THE VALUATION OF SPENT OXIDES FROM GAS-PURIFYING.

[By GEORGE E. DAVIS.

DURING the last year I have made several complete analyses of the spent oxides from gas-works, and have seen the reports of other chemists mentioning only water and sulphur, it being supposed that they were the only constituents in which the manufacturer of oil of vitriol was interested. Now, although the purifying material is nearly always sent to the gas-works, little else than ferric hydrate mixed with a little sawdust it mostly leaves as a complicated mixture, some of its constituents exerting a very injurious action in the vitriol manufacture. The amounts of these ingredients should be estimated so that the material might be correctly valued. If we suppose the sulphur to be mixed with ferric hydrate only, a sufficient current of air, together with the requisite degree of heat, would eliminate the sulphur to under 1 per cent, calculated on the resulting burned oxide; but when bases are present which combine with the sulphur dioxide, which further produce sulphates when exposed to heat and an oxidising agency, the value of a material would be less in proportion as the bases increase. The only base likely to be present is lime, which may either result from faulty manufacture, or may be added at the various gas-works where the oxide-purifying system is used. The next impurity which acts injuriously towards the vitriol manufacturer is the ammonia, existing in the material as ammoniacal salts. The ammonia, by its action upon nitrogen trioxide, renders it imperative to work with more nitre than is absolutely necessary for the oxidation of the sulphur dioxide, but these soluble salts can be easily washed out, and valuable ammonia obtained, and it only

wants a little management to extract both acid and base in a separate form. It is the lime then which requires to be carefully estimated, and this may be seen by the following analyses:—

	I.	II.	III.
Sulphur	64.376	62.358	67.956
Ferric hydrate	14.421	17.112	15.335
Insoluble	11.052	5.099	8.304
Moisture	2.079	5.387	3.900
Lime (combined with S) ..	2.399	—	—
Sawdust	2.470	1.776	1.002
Calcium carbonate	—	5.135	3.006
Ammonium sulphocyanide ..	2.662	1.324	1.102
„ chloride }	0.605	—	—
„ cyanide }	—	—	—
„ ferrocyanide	—	1.663	—
Iron ferricyanide	trace	0.366	trace
	100.064	100.220	100.605

The following is the analysis of a sample of the burned oxide:—

	Wet.	Dry.
Moisture	15.228	—
Insoluble	28.302	33.386
Ferric oxide	44.420	52.399
Calcium sulphate	11.288	13.315
Sulphur	0.762	0.200
	100.000	100.000

ON HEAT.*

By FREDERICK GUTHRIE, B.A., F.R.S., &c.

THE subject of this lecture was "Ebullition and Radiant Heat."

The phenomenon of boiling was first considered. When a liquid receives such a quantity of heat, and so rapidly, that its cohesion is so diminished that its tendency to form vapour overcomes the pressure of the air, the liquid forms bubbles of its own vapour, and is said to be boiling. The singing of the kettle, when beginning to boil, is due to the rapid ascent of small bubbles formed at the lower portion of the liquid, which collapse, and the shocks which such collapses give to the air produce musical sounds. Thus a regular succession of bubbles may rise from some rough surface, in rhythmic sequence, more frequently than sixteen times in a second, and produce a musical note. To measure the relation between the pressure of the air and the temperature at which a liquid boils, an instrument called Marcet's boiler is exceedingly useful. It is a strong copper sphere, air-tight throughout, and containing Hg at the bottom and water above. When heat is applied the steam cannot escape, but forces the Hg up a tube—a pressure-gauge—which dips into the Hg, and, while the pressure increases, the increase of temperature is shown by a small thermometer communicating with the heated water or mixed atmosphere inside. At ordinary temperatures water boils at 100° C., but on the top of a hill it boils at a lower temperature. Hence by increasing the pressure the boiling-point is raised, and by diminishing the pressure the boiling-point is lowered. Let us take alcohol, slightly warmed, and diminish the pressure by withdrawing the air which exercises the pressure. One of the three forces which kept the liquid in equilibrium at that temperature has been diminished, so it boils. Similarly water may be made to boil below 100° C., by taking off the pressure of the air which is restraining it. Take a flask of boiling water, from which the air has been forced by the steam, and cool it gently. What happens? The water boils again, by the withdrawal of heat, because the steam is condensed into water, which does not occupy so much space and has not

* Abstract of the fifth of a course of Lectures to Working Men, delivered in the South Kensington Museum on Monday, the 15th ult.

so much tension, thus allowing the water to rise as vapour. So, in the cryophorus, we saw how the condensation of the vapour of water by freezing released the pressure upon the surface of the water in a neighbouring vessel, and allowed the water to evaporate more rapidly, so as to cause it to freeze.

That the atmosphere presses seriously on all bodies—that it requires a considerable elastic force in the steam to thrust back the atmosphere pressing upon it—may be simply shown. Take a closed vessel full of steam, and you have the condition of the elastic force of steam exactly taking the place of the pressure of the atmosphere; but remove the pressure of the steam by condensing it, then no restraint is exercised, and the sides of the vessel fall in—collapse.

Different liquids have different boiling-points, as seen in the different vapour-tension of alcohol, water, and ether, when introduced into the barometer. This proneness of different liquids to rise, with varying powers, in the form of vapour, is due in some degree to their chemical composition,—of course depending also on the quantity of pressure; but that is not all. The temperature at which a liquid boils also depends upon the nature of the surface of the vessel in which it is heated. Hence, under ordinary circumstances, water in a clean copper vessel boils at $100^{\circ}\text{C}.$, but it can evaporate at temperatures below this; and when the containing vessel is of a higher temperature than itself, the liquid assumes a peculiar form called the spheroidal state. If you take a basin made of silver, which is known to conduct heat very well, heat it almost red-hot, and pour a little water into it, the heat radiated from the silver evaporates the lower surface of the water so rapidly that there is a little cushion of steam between the globule of the water and the heat of the plate—the liquid evaporating in the spheroidal state being shown on the screen. This state of water, which thus fails to come into contact with the mass of metal hotter than $100^{\circ}\text{C}.$, is sometimes supposed to be the cause of boiler explosions. Blacksmiths, in tempering steel, are particular to have the water which they use clean, and such as we generally employ. If the water is soapy, the metal does not touch the water, and is not cooled sufficiently rapidly. Plunge a red-hot copper ball into a solution of soap; on taking it out it will still be red-hot, and you can see, by the glow inside the water, that the two are not in contact. Soap-bubbles are blown by the hot metal, and the space between the metal and the soapy film is constantly occupied by the passage of steam between the two.

We turn now to the chapter of "Radiant Heat." With regard to the rate at which radiant heat travels, the best measurements are those which depend upon the intimate association between light and heat. When the moon passes between the earth and the sun, causing a total solar eclipse, both light and heat are shut off from the earth; the moment the sun becomes visible its heat is felt. This shows that, as far as the distance of the moon from the earth is capable of telling us, heat and light travel at the same rate. The velocity of light is found to be about 200,000 miles a second, and the velocity of heat is concluded to be the same. Now when heat travels by convection, it travels as fast as the body which holds it; when by conduction, it travels at a still lower rate, for it may be reckoned, in the case of a bar of metal, by comparing feet with minutes or hours.

Radiant heat may pass through solids, liquids, and gases; and it passes, as we see, from the sun to the earth, through interstellar space, where there is little or no ponderable matter. Radiant heat passing in the latter manner is supposed, like light, to consist of rhythmic agitation of the particles of a supposed medium called "ether." Some people go so far as to say that this medium pervades also solid and liquid bodies; others suppose that it only pervades stellar space or *vacua*; and when the agitation of this force meets with matter, it communicates its peculiar vibrations to this matter, and

these vibrations are carried by the ponderable matter through itself. Conceive a point on a body giving out heat, to be joined by a straight line with a point on a body receiving the heat, and conceive the row of ether particles on that line to be set in motion in a manner similar to the motion of the particles of water when a wave passes along; each particle moving up and down, or to and fro, across the direction of the wave's motion. Such is supposed to be the nature of the ether's agitation when radiant heat is passing through it, and such a line of agitated ether particles is called a ray of heat; a collection of such rays is a beam.

Radiant heat, on striking a body, meets with various fates. Suppose that body to be a solid with parallel sides, then the ray of heat or linear system of vibration striking the surface, which may be smooth and metallic, is cast back or reflected; but if that surface be of wood, some of the heat may be reflected, but for the most part it heats the wood and stops there, warming the mass. If the heat strike some other substance, say rock-salt, it travels through, passing out parallel to its course where it entered. We may suppose three rays of heat forming a beam, and a portion may pass through a body (transmission, diathermancy), a portion may enter and warm it (absorption, athermancy), and a portion may be cast back from it (reflection). That is the fate which awaits a beam in all cases; but when one of these prevail over the others, we call bodies, roughly, transmitters, absorbers, or reflectors, of heat.

A ray of heat which strikes a flat, smooth reflecting surface is so cast back that it makes, after reflection, the same angle with the reflecting surface, or with a perpendicular to it as it did before; and the incident ray, the reflected ray, and the perpendicular to the surface at the point of impact, are all in one plane. To prove that radiant heat obeys this law, reference must be made to another means for detecting small quantities of heat, and that means is an electrical one. If two ends of unlike metal bars are joined together, and the other ends connected by a wire, the slightest change in the temperature of the joint causes a galvanic current to pass through the wire. A number of such couples joined together give a thermo-electric battery or pile. The presence of the current, and therefore of the heat which causes it, is judged of by the deflection caused by the current on a neighbouring magnetic needle. If the current pass from south to north above the needle, the northerly end of the needle will turn to the west. By means of a hood, the heat radiated towards the face of the pile is concentrated on them. Place a candle at a certain distance from the pile, and that candle may stand for any length of time without moving the needle, but if a simple tin tube is introduced between the two, the needle quickly turns, showing that the heat has struck the metal tube, has been reflected backwards and forwards, just like sound, and so was concentrated on the face of the thermo-pile.

Two spherical mirrors may be used to show that the law of reflection is true. It is easy to prove geometrically that if the ray of light striking such a mirror parallel to its axis be very near to this axis, the point at which the parallel rays are converged is nearly half the radius of curvature, and inversely the rays coming out from that point will be reflected in lines parallel to the axis. These parallel rays strike the other mirror, and are cast into a second focus, thus forming conjugate mirrors. A red-hot copper ball was placed in one focus and a little gun-cotton in the other, and the heat radiated from the ball and reflected was sufficient to inflame the cotton. In fact, the power of polished metal surfaces to reflect heat is well known, as in the action of a Dutch oven before the fire, and firemen using a polished metal helmet, that the heat may not affect the head, but be reflected.

For some time it was thought that cold is reflected as well as heat, but we do not recognise cold as a thing or a state, but simply as the absence of heat. If a mixture of ice and salt (freezing mixture) be placed in one focus of

the spherical mirrors, and a thermometer in the other, apparently cold is reflected. Now we have to explain this phenomenon according to the hypothesis that there is only one thing—heat, and the absence of that is cold, and that has induced people to look upon the state of matter with regard to heat in this way. It is supposed that all bodies are giving out heat to all other bodies, but that the balance of exchange is in favour of the colder bodies. When I hold my hand by the side of the flame of a candle I am receiving heat, and it is supposed that my hand is giving out heat just as much when I hold it near the flame of a candle as when near a mass of ice, but in the latter case my hand gives out more heat than it receives. The face of the pile may be placed in one focus and the freezing mixture in the other, when the pile is found to give out more heat than it receives, and therefore becomes cold. The pile may be looked upon as the red-hot copper ball, and the freezing mixture as the gun-cotton. It is only by thought of this kind that one can reconcile this apparent radiation of cold with the well-accepted idea that there is no such thing in the abstract.

Attention was lastly directed to two pots containing hot water to begin with, and kept at the same distance for some time over a sheet of hot iron, to prove that the heat radiated from the plate, and was reflected more from a bright metallic surface than a dull, sooty one. A companion experiment was made with two pots filled with the same hot water at the same time. The black one was found to be cooler than the bright one, the bright metallic surface refusing to let the heat pass out, just as it refused to let the heat pass in. And so, if you wish to keep water hot for a long time, as you do in making tea, you get hotter and stronger tea by using a metal teapot instead of a dull or earthenware one—the same nature of surface which allows heat to enter a body freely, allows it to leave the body freely, or good absorbers are also good radiators.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, December 2nd, 1873.

Rev. WILLIAM GASKELL, M.A., Vice-President, in the Chair.

MR. HENRY H. HOWARTH, F.S.A., was elected an Ordinary Member of the Society.

The following letter from Mr. Henry Bowman, of Brockham Green, Surrey, dated 27th November, 1873, was read:—

Seeing the report of Prof. Reynolds's experiments on the nature of the explosive force of lightning, it occurred to me that the Society might be interested in an account of a remarkable thunderstorm which took place here on Friday, the 7th inst. I was not at home at the time, and did not hear of the storm until my return the following week. The Vicar of this place sent a short notice of the storm to the *Times*, copy of which is enclosed, together with some further particulars which he has kindly jotted down.

"The Rev. Alan Cheales . . . writes to us : . . a remarkable storm burst over the valley between Dorking and Reigate on Nov. 7. . . In general we have a remarkable immunity from thunderstorms, which draw away along the Downs to the north of us. The storm came up suddenly from the N.W. . . I have just returned from inspecting an oak tree in Betchworth Park . . . which was completely cleft in two. . . The tree has been chopped down within about 10 feet of the ground. . . The girth is about 8 feet."

Nov. 20, 1873.

My dear Sir,—In reply to your enquiries relative to the very remarkable thunderstorm of Nov. 7, mentioned in the *Times* of Nov. 12, I have much pleasure in putting before you such other particulars as I have been able to gather. There was no warning whatever; a black cloud rolled up, a little rain, and then two tremendous flashes. The tree struck was a fine young oak, half covered with ivy, in a row with other oaks, some also having ivy on them. E. Batchelar, painter, at Dorking, 2 miles off, describes a tremendous flash of blue light, and thunder instantly. Rev. G. R. Kensit, walking in fields about 1 mile off, described a ball of blue fire, which seemed to fall on his foot. Martha Rapley, coming home through Betchworth Park with perambulator and two children, was only 300 or 400 yards from the tree; was so stunned and blinded that she saw nothing—perambulator seemed wrapped in flames—she did not know whether the children were dead or not until she got home: neither injured. J. C. Richards, Esq., of Boxhill Farm, had a sheep killed about $\frac{1}{2}$ a mile off; he seemed to think it was killed by the same flash that split the tree: there was only one other flash. The tree, unfortunately, was removed at once by Mr. Hope's woodreeve. I could not see that any part was blackened. Mr. Richards observed to me that no conceivable human force could have so split it. Part of the fibre had been made to writhe round in a most remarkable manner. Huge splinters (3 feet by 3 or 4 ins.) were chopped out, and lay a few feet off. The tree was divided, and hung each side of the fence about 8 or 10 ft. from the ground. The lightning seemed to have run down thence along the outside bark into the ground; but the marks were slight. The tree was still solid below the cleft.—I am yours faithfully, ALAN CHEALES.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, November 27th, 1873.

Dr. LUNGE, President, in the Chair.

THE following paper was read by Mr. P. A. BERKLEY "On the Practical Employment of Dynamite":—

The reason I obtrude the following notes on "dynamite," or Nobel's patent safety powder, or, as the Americans call it, "giant powder," is that many manufacturers and others may not know the value of it, or may, like myself, not even have heard of its properties, until compelled by necessity to seek it out. I will not attempt to give its chemical properties, but simply state the need I had for such an agent, and my experience in its use during some months.

In the early part of the present year we took down one of the blast-furnaces at Jarrow, which had been in operation more than ten years, in order that a larger and more economical furnace might be built in its place. When we commenced to take out the foundations for the new furnace, we found that for several feet below the hearth it was one solid block of iron, about 10 feet diameter, I suppose, the weight of which could not be less than 125 tons. As this block was not in the centre of where the new furnace was intended to be built, and as it might again become fusible, and so injure the new furnace, it was absolutely necessary to have it removed. The two courses open were either to excavate under it, and so bury it, or to break it into pieces that could be removed. The latter course appeared preferable, for the value of the iron broken up so that it could be re-melted was about £3 per ton; consequently I had holes drilled into the iron, about 1½ to 2 inches diameter, and filled with gunpowder, well stemmed, but the discharge had not the least effect. Steel wedges and other methods were tried, but proved of no avail. I then made enquiries as to other explosives. When I heard of dynamite I put myself into communication with Mr. F. H. Edwards, the agent for the North of England, and with him I experimented upon a block of iron, about 2 feet 6 inches across, and 1 foot 6 inches thick, without

any hole being bored. Two cartridges (about $4\frac{1}{2}$ ounces) of dynamite were exploded on the top of it, but had no effect; we then exploded about 9 ounces, which broke the block clean in two pieces. I then saw that with holes bored it was possible to break up the whole lump. Four rattle braces were kept continually at work in drilling holes, $1\frac{1}{4}$ inches diameter, at about 3 feet apart. We could not drill the entire depth, so had to break off the top 2 feet, after which we took other 2 feet off, when we had sufficient thickness to form a good hearth. I may state that in some instances the explosion of the dynamite broke off the iron on the outside to the full depth, and the block was cracked through the centre. The whole of the block could thus have been broken up if time had not been more valuable than the iron. Some of the fractures were 4 feet by 3 feet, of the toughest cast-iron I have seen; doubtless it became so by cooling very slowly. The curious may ask, How did this quantity of iron get there? This is easily answered. The hearth of the furnace was laid with fire-brick lumps, 2 feet high, of a wedge form, so that they could not rise, but in process of time these melted out; under these were ordinary fire-bricks, laid in lime. When the fluid iron came upon them, they, being the lighter, were floated up and were melted; so it continued until the iron got through the foundations on to the clay. Some four or five years since I was much troubled with this furnace; we "tapped" it at the usual times, but for days we got no iron out, the charges were put in, and the slag ran as freely as ever, but no iron came (a wag suggested that they had tapped her from "below"). The furnace was allowed to stand open for some time with the blast off, after which it worked as productively as ever.

It may be interesting to many to know what dynamite is, what are its properties, and how it is used. Dynamite is composed of 75 per cent of nitro-glycerine, well mixed with 25 per cent of an infusorial earth, known as "kieselguhr," which is sufficiently absorbent in quality to prevent exudation. It is of a light brown colour, and when in a proper state for use is of a pasty consistence. It should be kept at about 50° or 60° of temperature; when cold it is not so effective. Dynamite explodes at 420° F. I consider dynamite much more safe than gunpowder; when laid open and set fire to, it quietly burns away. Our men were all perfectly new to its use, and never had the slightest accident with it. It always exploded when a lighted match was applied, never without, and it never hung fire. Although I have not tried what concussion dynamite will stand, it has been tested by a case containing 56 lbs. of dynamite being thrown from a height of 130 feet into a quarry, and it did not explode. It explodes in one-twentieth of the time it takes gunpowder, and is three times as powerful. With its rapidity of explosion the downcast force, although not confined, is strangely great, as instanced in the block of iron, $2\frac{1}{2}$ feet by $1\frac{1}{2}$ feet, being broken in two by about 1 lb. of dynamite, whereas powder, without being confined, would have had no effect. Dynamite in exploding does not scatter the fragments about like gunpowder, unless the hole has been fired two or three times, and become much shattered. For instance, the breaking-up took place between two blast-furnaces, only some 20 feet distance; at the back, about the same distance, were the heating stoves, and close at hand were the water-pipes for supplying the furnace tuyeres and boilers, also the blast main and waste-gas tube, and yet no injury of consequence occurred. Certainly, a few pieces did fly, one piece about 10 lbs. weight, was thrown across the river into Willington Quay, breaking the top of a shop door frame, and rather startling an old couple that were passing at the time; but I can assure you that I was heartily glad when I got through my work, and was thankful that amidst such a dense population no serious damage was done. At first we tried, by putting timbers across the holes chained together, to prevent the pieces flying, but it made matters worse, as the timber was scattered about fearfully. At times, when we used a large charge, say 2 lbs., the concussion was terrific, shaking the

whole place. There is no stythe from it like gunpowder, and therefore in that instance it is well adapted for mines where the ventilation is not good. Dynamite must be most valuable for blasting among water, as no damp affects it.

The using of dynamite is very simple; it is supplied from the manufactory in cartridges, about 3 inches long, and about $\frac{7}{8}$ of an inch diameter, weighing between 2 and 3 ounces. A special fuse is made for it, but any ordinary fuse will answer. The end of the fuse is cut clean and square, and inserted into a special cap or detonator; the cap is fastened on to the fuse by a pair of nippers (a little tallow may be put upon the joint to keep any water out of the cap); the cap is then inserted into a small cartridge called the primer; the parchment having been opened to receive it is tied over the fuse to prevent it coming out of the cartridge; the hole that has been drilled is filled with water, and a sufficient number of cartridges put in (I have put in as many as twelve in one hole) and each pushed home by a piece of wood (iron should not be used), so as to fill the hole, and all come close together; on the top is placed the primer cartridge, with the fuse attached, and cut to a sufficient length to let the men get away. The hole being filled with sand, or water, which is better, as water does not in the least injure its action, the fuse is fixed, which communicates with the fulminating powder in the cap, which explodes the dynamite.

Frequently, if the block is large, the first explosion will not break it, but the hole will have been made more than twice the diameter, so that double the quantity of dynamite may be put in the second time, which is pretty sure to do execution.

I need not say that nearly every one seems to dread "nitro-glycerine;" perhaps we have good reason, for the terrible accident that hurried our amiable townsmen out of the world is still fresh in our memories. But this preparation of it seems to me perfectly safe. It has for the last eight years been used very freely on the Continent, where there are some ten or eleven manufactories, one of which, near Hamburg, produces more than 1000 tons annually, and every facility is given, both by the governments and railway companies, for its transportation and use. It is not so in this country, as before using it you must have a special license from the Home Secretary, and the conditions of license are most arbitrary and binding. Many of the railways, among them the North Eastern, absolutely refuse to carry it, and as the only manufactory in Great Britain is at "Ardeer," on the coast, about thirteen miles from Glasgow (The British Dynamite Company), it must either come by sea or by the underground railway. It is not for me to say how I got it. I had a conference with Mr. John Downie, who feels keenly the prohibitions of the Government and railway companies.

Mr. BERKLEY exhibited a nitro-glycerine cartridge and fuse.

Mr. PATTINSON asked if it was not a fact that there had been a good many accidental explosions of dynamite?

The PRESIDENT said, Mr. Berkley had made a remark just now about explosions from dynamite being unknown. It might be that, after it was once manufactured, it became comparatively harmless without being exploded at will. But it was known to him (the President) that one of the manufactories on the Continent, where it is made, had already twice been entirely destroyed by an explosion. On the last occasion it was so entirely destroyed that it was quite impossible to make out in what way the explosion happened, because everybody present at the time of the accident was blown to atoms. It was a personal friend of his own to whom the manufactory belonged, and who, fortunately for himself, was not present at the time of the last accident. Still, although this was a fact, which he knew from personal knowledge, yet it might be that Mr. Berkley was quite correct in this—that when once kieselguhr was impreg-

nated with nitro-glycerine then the explosive properties of the nitro-glycerine were so far subdued that it could be handled in comparative safety. That the gentleman who was in these factories was not an amateur, or one who could be blamed for his own ignorance on account of these explosions, was, he thought, proved by the fact that he was employed by Mr. Nobel to go out to California, and introduce the manufacture of it there, so that he must have been competent in the matter. Perhaps it might interest them to hear that he did not go out until Mr. Nobel had insured his life for £3000. It is perfectly correct, to his own knowledge, what Mr. Berkley states, namely, that dynamite is in quite regular use on the Continent for mining operations, and by different governments for operations of war; and its manufacture and its carriage are not subject to any but reasonable precautions. It seemed as if now the proper medium had been found to make nitro-glycerine available for the purposes to which it was from the very first destined, but which it did not fulfil, on account of the very great danger connected with its handling; but it might be interesting to say that a great many absorbents of nitro-glycerine had been tried, but that they had all failed. The inventor of dynamite, Mr. Nobel, had the monopoly of the special substance which Mr. Berkley mentioned, namely, kieselguhr; and in order to be able to manufacture a similar article, a large number of other bodies had been tried, but none of them had succeeded to anything like the extent of kieselguhr. It is found, at least in large quantities, only in one spot, near Luneburg, in North Germany, but it is found in immense quantities there, and, so far as that was concerned, there was not the slightest difficulty in getting a sufficient supply of it. It is nearly pure silica, and consists of shells of infusoria of past ages. It was a whole geological bed, and so far no other use for it exists; at least the other uses to which it had been put had been given up—for instance, the manufacture of water-glass.

Professor MARRECO thought the paper a most interesting one, and a valuable addition to their knowledge of nitro-glycerine preparations; but he must say it had not in the least increased his faith in them. He believed that for these purposes gun-cotton was the safest. He had a good deal to do with this when it was attempted to introduce it into this neighbourhood, and he was not very sorry it was not introduced; but he did believe that nitro-glycerine is thoroughly and radically unsafe. They were told it was innocuous; yet they somehow heard of its exploding under some conditions or other which were never ascertained, because, unfortunately, as Dr. Lunge observed, there was very seldom anybody left to tell you anything about it. There was another instance of the dangerous character of the whole class of compounds of this nature, and that was the explosion, probably of nitrate of methyl, which the late Mr. Chapman was destroyed by. Here was the fact, that Mr. Chapman, than whom no man could be more careful, was destroyed by this compound, under circumstances which they knew nothing about. All they could say was that the whole place was blown up. With regard to the stythe from that part of the nitro-glycerine which was not exploded, he did not see why a little silica should make it less stythey; and they knew that the men complained greatly of the stythe in close pits.

The PRESIDENT said, that when Mr. Berkley was reading his paper he was thinking himself of the stythe from nitro-glycerine or dynamite, which are quite identical in this respect, and he considered it certainly as bad as that from gunpowder in a confined place, but perhaps not in an open place; and as he understood that experiments had been tried only in open places, it would not be so conspicuous, because there was no smoke from it; but the stythe would be just as bad as from gunpowder, perhaps worse, only there would be no visible smoke. He did not think Professor Marreco's objections to dynamite were quite so valid as he thought them, because practice had a great deal to say in these matters; and although

Professor Marreco did not see any physical reason why the admixture of 25 per cent of a porous material should make nitro-glycerine so much less dangerous than it is in the liquid state, yet it was a fact which had been tried not only by a few show experiments before an unscientific audience, but by practice. He did not believe in such things as show experiments himself; but it had been tried by many years practice. He did not think it was requisite to carry such explosive compounds in the same train as passengers. If that were the case, he thought the objection would be perfectly valid, but prohibiting the carriage of such substances altogether, in any sort of trains, was, he thought, going too far; but it was not for him to tell companies what they were to do and what they were not to do.

Mr. BERKLEY had consulted those who had used explosives, and he could not find any other agents which would break up the iron except dynamite. Gunpowder had not the slightest effect upon it; and it was really wonderful with what a small charge it was done. Even the small cartridge, a specimen of which he produced, was tried, and the blast splintered and cracked it in almost every part. To put in an inch and a half after the first discharge would make it a two and a half inch hole. How it deepened it, and where the material went to, it was difficult to tell; but such was the effect. With reference to the explosion at the manufactory which Dr. Lunge had mentioned, it ought to be borne firmly in mind that it was not dynamite which exploded, but glycerine. Of course nitro-glycerine would explode, and dynamite as well, but what he contended for was that dynamite, in the form in which we can now get it, is a safe substance to use. He would also state that in ironstone mines where they had used it, it had not proved of more value than gunpowder. It does not shatter the stone as gunpowder does; and in ironstone mines they were obliged to use gunpowder to shatter the stones, but dynamite throws a great lump off. With reference to what he had said about stythe, he should, perhaps, more correctly have said smoke. There was not the slightest smell that he had experienced from explosions of dynamite. Now, anyone who had exploded gunpowder in mines, as he had done, knew that the stythe for several minutes afterwards was almost unbearable.

GEOLOGISTS' ASSOCIATION.

At the meeting of this Association on the 2nd January, a paper was read by Mr. HAWKINS JOHNSON, F.G.S., on "*The Nature and Formation of Flints and Allied Bodies.*"—The object of the paper is to show the nature of several members of a large group of bodies occurring in sedimentary deposits of different ages, and which are generally known as nodules, and described as concretionary. Those specially alluded to are the septeria from the London and Kimmeridge clays, the flints from the chalk, the iron pyrites from the chalk, the phosphatic nodules of the Gault, the clay ironstone nodules of the carboniferous series, and the ironstone from the Woolwich beds.

By the gentle action of solvents, the structure of these bodies is revealed so as to be easily examined by the microscope. They are then found all to agree in possessing a silicified organic structure, which may be described as a network of fibres, or a mass permeated in every direction by anastomosing canals. This structure was subsequently filled in with other material, such as carbonate of lime, silica, bisulphide of iron, phosphate of lime, carbonate of iron, &c., the particular substance thus filled in depending upon the relative abundance of the substances dissolved in the interstitial water of the surrounding matrix.

The singular groups of concentric, siliceous, circular bands seen upon many fossils, and known as orbicular silica, or beekite markings, are also explained. The fossils

on which they occur were imbedded in a matrix more porous than themselves, and of irregular constitution, so that the evaporation, to which the consolidation of the dissolved silica in their pores was mainly due, occurred at a number of points on the surface of the fossils, at which points a deposit of silica took place, forming the central tubercles. The cessation of evaporation was followed by a fresh saturation with the solution, to be again evaporated; but as the evaporating points were now plugged up by the previous deposits, the silica last consolidated was deposited around their margins and upon them internally, appearing outwardly as a ring round the tubercle. Alternations of these conditions account for the numerous bands seen in some of the groups.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, December 1, 1873.

Note Accompanying the Presentation of Poncelet's "Cours de Mécanique Appliquée aux Machines."—M. Resal.

Terrestrial and Solar Waterspouts (Trombes).—M. Faye.—The author follows up his reply to M. Tarry (see vol. xxix., p. 10) by a direct examination of the facts. He quotes a page or two from Dr. Reye's work describing the phenomena. The waterspout is shown to be a sort of machine, an apparatus for transmission of force, and doing enormous work at one of its extremities. Where is the force thus transmitted? Is it below or above? Below, the air is usually calm, and it is in the heart of the calm that waterspouts often appear. It seems doubtful that the force can come from the heart of this calm. In any case it would only be distributed over a wide space; then how could it accumulate at a particular point, and how could this point of concentration travel along in the immobile layer? Further, the only force which may exist in the latent state in an immobile layer is the rising tendency produced by abnormal rise of temperature. It must be a very weak force at each point of the layer, but, if all the forces were united in a small space, their sum might be considerable. To produce this, the elementary forces must be hindered from producing their effect where they are generated. The weight and cohesion of the upper layers must oppose, for some time at least, the ascent of all the fine air-currents which ordinarily arise in a fluid medium to restore the equilibrium. We have here a restrictive condition; still, this state of instability is sometimes produced for some time. It occasions mirage; but a complete calm is necessary for it. If the wind blows, there is a mixture of layers unequally heated; the small ascensional forces do the work *in loco*. Thus we already see that waterspouts would never be able to arise in moving air; but they do; hence we must seek the origin of their force, and its aliment, elsewhere than in the inferior layer. The author next represents the accumulation of hypotheses constituting Dr. Reye's theory of ascending waterspouts in calm air; horizontal convergence of the various parts of the layer to a particular point; a column of air rapidly ascending from an annular orifice at this point; the forces, previously distributed over a large extent of land, engulfed, as it were, in the annular space; the rising column carrying up vapour, which soon condenses; progressive displacement of the cloud along with that of the ideal annular orifice; the latter moving in the direction where the weakest of all the convergent currents comes to it; its movement due to the difference of two velocities

diametrically opposed; rise and fall of the currents along with rise and fall of the ring, &c. With regard to waterspouts in agitated air, the theory is dumb, for here there is wanting the essential element of force. What could cause the air of a vast horizontal layer to flow thus violently towards an ideal annular aperture? It is undoubtedly not because a first file of molecules has passed that all the others in a radius of several leagues would be forced to do it also. This conception is at variance with the idea we are led to form of the laws of Nature, which does not expend a large amount of work where it is easy to reach the end by a small expenditure. For, if we consider it, the point here is only to restore the equilibrium (deranged for the moment) of a layer of air. To prop up the hypothesis of ascending waterspouts, it has been necessary to expressly imagine a mechanical process quite inadmissible for the magnitude of the phenomenon; it has then been necessary at each new *trait* to adduce fresh causes not less singular; and all without furnishing an explanation of well-characterised phenomena, such as that of a waterspout progressing against the inferior wind. On the other hand, consider the simple facts. Here is a true machine—on one hand, the force; on the other, the work produced. If we cannot find the force below, *where there is no movement*, we have only to raise our eyes to the mouth of the waterspout; there we find storm-clouds moving with a high velocity, showing that there is force above. The waterspouts are formed above at the expense of these vast currents, which have invaded the upper regions. Not that the currents themselves generate waterspouts; but we know, from the daily example of our watercourses, that differences of velocity in neighbouring sections give rise to gyratory movement. Now this gyratory movement, which may enclose vast spaces, collects, and makes to converge to a centre, those *pre-existent* inequalities of velocity. It sums them up, so to speak, in a vortex, the rapidity of which increases towards the centre, and transmits from layer to layer all this *vis viva*, until it is exhausted below on obstacles. In air, the summation and transport are a thousand times easier than in water, the loss due to friction being small. The waterspout is propagated downwards through the successive layers of the atmosphere, reaching the ground almost without having lost any of its energy. At the moment of contact it acts against the resistance, and produces devastative work, a strict representation of the *vis viva* which was stored up above. If it comes to a valley where its point ceases to touch the ground, the work ceases also, but then the point re-commences to descend, and soon resumes its ravages. These are nearly limited to the circle embraced by the base of the waterspout, but the cold air which escapes, and is re-heated, rebounds on the ground, and rises tumultuously about the waterspout. Thus we see the meteor surrounded at its base by a cloud of ascending dust, and in the sea with a cloud of foam. It is thus that it raises light substances, but it never makes them pass through its funnel (as some have supposed). It matters little to it whether it act in calm or in agitated air; it follows the movement of its funnel, or of the upper current which supplies it. If the inequalities of the current are diminished, the waterspout loses its force; it ceases to reach the ground; it gradually rises, and seems suspended for a time like a horn, ready, however, to re-commence, if the current above experiences resistances or eddies. The author remarks, in conclusion, that the discussion has made marked progress lately, especially in Germany, thanks to Dr. Reye's letter and a recent memoir by M. Zöllner. In Germany, the depth of the spots is now accepted; neither M. Zöllner nor M. Reye places them on the photosphere, but they are supposed embedded in its thickness. This supports the author's theory, and is against that of clouds.

Double Refraction; Directions of Vibratory Movement of Rays Refracted in Uni-Axial Crystals.—Memoir by M. Abria.—(Extract).—The author has found that there is sometimes a great difference between the

azimuths of the planes of polarisation of the incident ray, corresponding to the extinction of the ordinary or extraordinary refracted ray, according as the incidence is normal or oblique. He sought to deduce from such differences a verification of Fresnel's theory of double refraction. In fifteen experiments, made with two prisms of spar and of quartz, the difference between calculation and observation varied from a few minutes to 3 degrees.

Observations on M. Faye's Communication.—Gen. Morin.—The author draws attention to the phenomena produced behind obstacles in the rapid stream of a river.

Analytical and Experimental Study of the Interferences of Elliptic Rays,—Memoir by M. Croullebois.—(Extract).—Elliptical polarisation, it is known, forms the transition between rectilinear and circular; for the former of which the conditions of interference have been defined by Arago and Fresnel, and verified by Fizeau and Foucault; for the latter by Fresnel, Babinet, and Billet. The author thus seeks to complete the study to some extent.

Carrier Pigeons which Returned to Paris During the Siege.—M. de Fonvielle.—The value of the service rendered by the seventy-three pigeons which returned during the siege has been exaggerated; only sixteen are thought to have been of use with reference to movements of the armies of defence. Of forty-three balloons, twenty furnished pigeons which returned. The most useful balloon was the "General Uhrich," which took with it thirty-six pigeons, fourteen of which returned. It appears from a study of the two branches of the aerial service that it is too late to organise an art of the kind satisfactorily when under the enemy's fire.

Theorem of Celestial Mechanics.—M. Siacci.

Movement of an Elastic Wire, One Extremity of which is Animated by a Vibratory Movement.—M. Mercadier.—The writer gives an equation which represents this movement, and shows how the consequences of it are identical with the experimental laws previously indicated.

Note on Magnetism.—M. Treve.—The author had formerly called attention to the magnetic movement produced by magnetisation. In the heel of an electro-magnet, induction currents were obtained, the direction of which varied with that of the inducing current; this he attributes to the action of a magnetic intermolecular movement exchanged between the poles. Prosecuting the study, he took a long iron bar, one end of which had a strong inducing bobbin, while an induced bobbin could be slid along; and he has examined the conditions in which the magnetic movement is propagated, and observed, *e.g.*, the very rapid decrease of intensity of induced currents generated from the same inducing force, in proportion to the withdrawal of the induced from the inducing bobbin, as also the influence of the section of the bar on the intensity of these currents. What he thinks the most useful result is the ascertaining of a notable retardation of the induced currents (or "*d'arrivee*") or the inducing currents (or "*de depart*"); that is to say, that the magnetic movement is slow relatively to the electric movement. He proposes to try and measure the velocity of propagation of this kind of movement.

Difference of Physiological Action of Induced Currents According to the Nature of the Metallic Wire Forming the Induced Bobbin.—M. Onimus.—The author made exactly similar bobbins of copper, lead, and German silver wire. When the wire of the bobbin is a bad conductor of electricity, the muscular contraction produced is stronger, and the impression on the cutaneous nerves is less vivid than with good conductors, as copper. These effects are more marked the greater the exterior resistance. The current induced in bad conductors has greater tension than that in good, and less quantity. Coils of German silver wire may, in accordance with these facts, be advantageously used in electro-medical apparatus.

Zeitschrift für Analytische Chemie, von Dr. C. R. Fresenius, Zwölfter Jahrgang, Zweiter Heft, 1873.

Superphosphates Containing Iron and Alumina, and their Analytical Examination.—Dr. Alwin Rümpler.—The author refers to the phosphorite from the Lahn, and to the "going back" or "reduction" of the soluble phosphate in the superphosphates prepared from that mineral. He satisfied himself, as far back as 1869, that the cause of this reduction was oxide of iron, especially in the state of silicate, and soluble alumina mixed with the phosphate. He now concludes that a soluble ferric salt of orthophosphoric acid is formed. This salt is decomposed by heat, a pulverulent basic salt being deposited, which does not re-dissolve on cooling, and is not soluble in free concentrated phosphoric acid. The same salt is also decomposed by the addition of water or of alcohol. The presence of mineral acids does not hinder these decompositions, only a larger amount of the decomposing agent being required to make the separation complete. The decomposition by heat can be hindered by the presence of an excess of acid. Non-volatile organic acids and their salts hinder also the decomposition by water. The precipitate formed on adding water to this soluble ferric phosphate is a pure tribasic phosphate of peroxide of iron. There is also a salt of alumina corresponding to the soluble phosphate of iron, and capable of decomposition under the same circumstances. The alumina in Navassa phosphate has the same effect as the iron in the Lahn phosphorite. The question now presents itself, Does the compound in question occur in ferriferous and aluminiferous superphosphates? Judging from the phenomena, this seems probable, or we must at least admit that such a compound is formed during the analysis, and under a variety of circumstances in the manufacture of superphosphates, by double decomposition of persulphate of iron and acid phosphate of lime. It has been observed that certain lots of superphosphate never dry if too great heat has been developed on mixing the phosphatic mineral with sulphuric acid. If we enquire what superphosphates possess this property, we always find them to be such as are prepared from materials containing lime or alumina. This point is easily explained if we consider that the soluble phosphate of iron is decomposed by heat. Along with basic phosphate, free phosphoric acid is formed, which never dries and does not re-dissolve the basic salt. If we attempt to dry up such a superphosphate by artificial heat, the evil is only increased. The best method is to spread out the superphosphate as soon as it is mixed. Hence, in the analysis of superphosphates, warm water should never be used to extract the soluble phosphoric acid present. The flocculent turbidity which is sometimes obtained on gently heating solutions of superphosphate, depends on the presence of iron. Neutral phosphate of lime is only deposited on prolonged boiling. In the analysis of superphosphates containing iron and alumina, it will be found that the smaller the quantity of water used in extraction, the more phosphoric acid will be dissolved. Lixiviation with small successive quantities of water is therefore the only suitable procedure, as recommended by Fresenius. In working with Lahn and Navassa phosphorite, we always find that, even immediately after the preparation of the superphosphate, the amount of soluble phosphoric acid never agrees with the calculated quantity, but is always smaller, except a large excess of sulphuric acid is present. The phosphoric acid cannot have gone back; the deficiency arises, therefore, from the imperfect method of analysis. Fresenius, Neubauer, and Lücke distinguish three states of phosphoric acid in superphosphates—(1) such as has never been rendered soluble, (2) such as has been "reduced" or has gone back, and (3) soluble. The author adds a fourth—such as has been rendered insoluble during the analysis. The values of these three differ—the soluble is the dearest, the insoluble counts for nothing (not in this country), and the reduced commands in some districts an intermediate price. Fresenius, Neubauer, and Lücke recommend a concentrated solution

of citrate of ammonia for dissolving out the reduced phosphate. The author prefers the oxalate. He calls attention to the possibility of finding less energetic salts or organic compounds which may prevent the precipitation of the phosphate of iron, without re-dissolving the reduced phosphate.

Behaviour of Alkaloids with Sugar and Sulphuric Acid.—R. Schneider.—The author examines the reactions of morphia, codeia, aconita, delphinia, chelerythrin and chelidonin. It must be remembered that besides the gall-acids, the protein bodies, and fatty oils give the same reactions.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin,
No. 16, November 10, 1873.

Reciprocal Behaviour of Ozone and Water.—Em. Schöne.—The author's results are as follows:—1. Ozone does not oxidise water to peroxide of hydrogen. 2. Ozone is absorbed by water in considerable degree, and this at the ordinary temperature of a dwelling-room; the maximum was 0.0189 grm., or 8.81 c.c. of ozone per litre, at a temperature of 18.2° C., and a pressure of 741.5 m.m. 3. In contact with water, ozone suffers no qualitative change. 4. If ozonised oxygen is passed through water, the proportion of ozone is diminished. 5. The disappearance of ozone is far greater than can be accounted for by its absorption in the water, and must therefore be ascribed mainly to a destructive action of the water. 6. In contact with water, ozone is gradually converted into common oxygen; this takes place at ordinary temperatures. 7. This change is attended with expansion. The author does not consider that rain-water can absorb ozone from the air, on account of the presence of nitrogen.

Analysis of Two Minerals from Greenland.—J. V. Janovsky.—The first of these minerals is a soft stone from inner Greenland, apparently belonging to the chlorite group; colour, dark green; streak, white; soft; fuses at the edges before the blowpipe, and gives the reaction of iron. Hydrochloric acid decomposes it imperfectly, even on prolonged boiling. It contains—

Silica	.. ..	30.32
Iron, protoxide	.. ..	7.71
Lime	.. ..	1.28
Magnesia	.. ..	29.88
Alumina..	.. ..	17.90
Water	.. ..	12.28
Phosphoric acid	.. ..	0.11
Fluorine	}	traces
Sulphuric acid		

99.48

The mineral approximates most closely to klinochlor. The second mineral was a rock resembling zircon-syenite from the island Kikkertarsursurok. It consisted of quartz, a kind of hornblende, eudialyte, nephelin, magnetic iron ore, and a triclinic felspar. The hornblende-like mineral is black, with a green translucence at its edges; its powder is dark green. Before the blowpipe it fuses easily to a black bead. Its composition is—

Silica	.. ..	44.24
Iron, protoxide	.. ..	29.46
„ peroxide	.. ..	4.27
Alumina..	.. ..	1.80
Manganese, protoxide..	.. ..	2.21
Lime	.. ..	8.84
Magnesia	.. ..	3.11
Potash	.. ..	1.31
Soda	.. ..	0.83
Phosphoric acid	.. ..	2.33
Loss on heating	.. ..	1.35

99.75

The mineral is therefore not arfvedsonite.

Synthesis of Uric Acid, and on Iso-Uric Acid.—E. Mulder.—A hypothetical paper, consisting chiefly of

structural formulæ. Iso-uric acid was deposited as a heavy powder on boiling together 2 grms. of alloxantin, dissolved in a minimum of boiling water, and 1 grm. of cyan-anamid, likewise dissolved in a minimum of water.

Ketons from Aromatic Hydrocarbons and Acid Chlorides.—S. Grucarevic and V. Merz.—The authors have examined— α - and β -naphthyl-phenyl-keton; α -dinaphthyl-keton; β -dinaphthyl-keton; diphenyl-keton; tolyl-phenyl-keton; cymyl-phenyl-keton; benzoate of benzoyl-phenol.

Splitting-Up of Certain Ketons by means of Soda-Lime.—S. Grucarevic and V. Merz.— α -naphthyl-phenyl-keton yielded naphthalin and benzoic acid; β -naphthyl-phenyl-keton gave the same products; α -dinaphthyl-keton yielded naphthalin and α - and β -naphthoic acid. Both the modifications of β -dinaphthyl-keton gave rise to naphthalin and β -naphthoic acid.

Gazzetta Chimica Italiana, Anno iii.,
Fascicolo x., 1873.

Researches on Chloral.—E. Paterno and A. Ogialoro.—The authors have examined the action of sulphuretted hydrogen upon chloral, as also that of dehydrating agents upon the sulphuretted derivative, and that of the pentasulphide of phosphorus upon chloral.

Filtration not a Trustworthy Means for Purifying Drinking-Water Contaminated with Choleraic Poison.—Dr. Dario Gibertini (of Parma).—The author combats the view that the germs of zymotic disease, especially cholera, can be removed from water by filtration. His microscopic observations have convinced him that filters do not remove certain low organisms from water. (This is a subject deserving very serious attention. If Dr. Gibertini's views be correct, irrigation and "intermittent downward filtration" must be powerless to deal with sewage containing the germs of disease, and germ-destroyers, such as carbolic and cresylic acids, are imperatively required in the treatment of sewage).

Researches on Cymen.—E. Paterno.—A preliminary notice.

Observations on Cymen.—Dr. Icilio Guareschi.

Determination of the Specific Gravity of Cymens of Various Origin.—G. Pisati and E. Paterno.—A lengthy paper not suited for abstraction.

Crystallisation of Sulphur in Forms Belonging to the Trimetric System.—Prof. O. Silvestri.—Goniometric measurements of the crystals in question, with determinations of their specific gravity, solubility in bisulphide of carbon, melting-point, and point of re-solidification.

Revue Scientifique de la France et de l'Etranger,
No. 21, November 22, 1873.

A View of Certain Chemical Manufactures.—M. Riche.—An account of the present state of the soda and of the superphosphate manufacture.

The Diamond Diggings of South Africa.—Desdemaines Hugon.—The author calls attention to the peculiar climate of the diamond district, and especially to the violent and continued electric action for which it is distinguished. He maintains that the air is always strongly charged with electricity where diamonds abound, and appears to suggest that this circumstance may throw some light upon their formation.

Experiments with Coignet's Manure for Beet-Root.—M. Dehérain.—Coignet's manure "A" was tried against "phospho-guano" (make and composition not stated), and against a mixture of the latter and of guano. All three were applied in equal quantity—600 kilos. per hectare. Coignet's manure appears to have given the greatest weight of roots, with the highest percentage of sugar, and with the smallest outlay. It gave also superior results to a mixture of sulphate of ammonia and superphosphate. Coignet's manure contains 6 to 7 per cent of nitrogen,

30 per cent of roasted bone-phosphate, and 50 per cent of organic (animal) matter, all reduced to a fine and easily-assimilable state.

MISCELLANEOUS.

Society of Arts.—The following papers will be read before this Society during the present session:—*Ordinary Meetings*.—"On Museums for Technical Instruction in the Industrial Arts and Manufactures of the United Kingdom, and the Appropriation of the Surplus of the Inventors' Fee Fund for that purpose;" "On German Music, with especial reference to the works of Richard Wagner;" "Account of a Recent Visit to the Coal and Iron Fields of Virginia, United States of America;" "On Eastern Art, and its influence on European Taste;" "On Type-Printing Machinery, with suggestions thereon;" "On Thrift as the Outdoor Relief Test;" "On the Channel Tunnel;" "On Bells and Modern Improvements for Chiming and Carillons." *Indian Section*.—"On Indian Teas, and the desirableness of Increasing the Use of them in the Home Market;" "On Indian Art;" "On our Relations with the Hill Aborigines of Northern India." *Chemical Section*.—"On the production of Anthracen and Alizarin from Pitch;" "On the Manufacture of Chlorine;" "On the Utilisation of the Waste Products of Gas Manufacture;" "On some recent Improvements in the Production of Carbonate of Soda;" "On Sugar Refining, with special reference to Fingel's Sugar Crystals." In the *African Section* the arrangements are not yet complete. Further particulars will be duly announced in the *Journal of the Society*.

The Gas Supply of the Metropolis.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has recently reported to the Corporation and the Metropolitan Board of Works the results of the testings of the gas supplied by the Chartered, the Imperial, and the South Metropolitan Gas Companies, during the months of October, November, and December last; from which it appears that the average illuminating power of the Chartered gas has been 17.34 candles at Beckton, 16.9 candles at Cannon Street, and 17.08 candles at Friendly Place, Mile End; that of the Imperial Company has been 17.10 candles at Carlyle Square, 16.22 candles at Camden Street, and 15.9 candles at Graham Road; while that of the South Metropolitan Company has been 16.34 candles. The Cannel gas of the Chartered Company has averaged 21.37 candles at Millbank, and 21.48 candles at Ladbroke Grove. As regards purity, Dr. Letheby reports that, except on two occasions at Ladbroke Grove, the gas at all the testing places has been constantly free from sulphuretted hydrogen; and that although the amount of sulphur in other forms than this has fluctuated to a rather large extent, yet it has rarely been above the prescribed quantity. In the common gas at Beckton it has averaged 12.73 grains per 100 cubic feet, at Cannon Street 13.41 grains, at Friendly Place 13.02 grains, at Carlyle Square 19.55 grains, at Graham Road 22.94 grains, at Camden Street 20.33 grains, and at Hill Street, Peckham, 25.55 grains. In the Cannel gas it was 21.4 grains at Millbank, and 20.4 at Ladbroke Grove. On seven occasions it exceeded the prescribed quantity, viz., once at Bow, once at Carlyle Square, and five times at Graham Road. On six of these occasions the Imperial Company appealed to the Chief Gas Examiner, in accordance with the provisions of the Act of Parliament, and on enquiry it was ascertained that the excess was due to unavoidable causes, arising out of the large demand for gas during the foggy weather of December last. Ammonia has not been present in undue proportion at any of the testing places but one—namely, that at Ladbroke Grove, where the amount for a considerable number of nights was excessive, thereby rendering the Chartered Company liable, under the 74th Section of the Metropolis Gas Act, 1868, to a penalty of £50 for each night of such default.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in treating explosive compounds to impart safety thereto for blasting and other purposes. Edward Augustus Leonard Roberts, Titusville, Pennsylvania, U.S., at present of 34, Southampton Buildings, Middlesex. March 14, 1873.—No. 926. This invention has for its object improved means of rendering fulminating powders and all fulminates, that are dangerous to handle in a dry state, comparatively safe and useful for blasting and other purposes, by mixing them and using them mixed or combined with water or some other suitable fluid or materials, such as hygroscopic salts, in such proportions as shall render them non-explosive by ordinary agitation, friction, or by a blow or concussion, but yet sufficiently explosive to be capable of being fired by any detonating or fulminating compound, or by some of the same material in a dry state. Explosive compounds treated in accordance with this invention may be packed or enclosed in air-tight envelopes of any suitable shape and material or construction so as to preserve them unchanged. The mixing of explosive compounds with fluids in this manner renders them more dense, thus allowing a greater amount to be held in a given space.

Improvements in the manufacture of the salts, carbonates, and hydrates of baryta and strontia, and also for improved modes of making baryta and strontia caustic. Edward Thomas Hughes, of the firm of Hughes and Son, patent agents, 123, Chancery Lane, London. (A communication from Louis Gustave Ghilain Daudenart and Edmond Verbert, 34, Rue du Progrès, Schaerbeck, Brussels). March 14, 1873.—No. 938. In order to produce the carbonates of baryta and strontia according to this process, I take alkaline earthy chlorides, not only because they are very soluble and that sulphates of baryta and strontia are obtained from them with facility and economy, but also that by means of this process I obtain free hydrochloric acid at the same time that the carbonates of the alkaline earths are produced.

Improvements in the treatment of the liquors used in scouring or cleaning wool. Edward Thomas Hughes, of the firm of Hughes and Son, patent agents, 123, Chancery Lane, London. (A communication from Louis Gustave Ghilain Daudenart and Edmond Verbert, 34, Rue du Progrès, Schaerbeck, Brussels). March 14, 1873.—No. 939. The object of this invention is—First, to extract the potash in a state of carbonate, which is its most valuable condition, by a process which is at once economical and expeditious; and, secondly, to completely extract the greasy matters which separate from the washing-liquors.

Improvements in the production of colours for dyeing, printing, and staining. Newton Athow, Plaskynaston, Denbigh. March 20, 1873.—No. 1043. My invention consists principally in utilising the waste or by-product obtained in the purification of crude carbolic acid derived from coal-tar for the purpose of producing colours suitable for dyeing, printing, and staining.

Improvements in the manufacture of glucose or grape sugar from rice and other grain, and in apparatus employed therein. Edwin Egerton Pearce, 7, Oberstein Road, New Wandsworth, Surrey. March 20, 1873.—No. 1044. The invention relates to converting rice and other grain into glucose or grape sugar by feeding such grain through a sealed feeder under steam pressure direct into a saccharifier provided with a revolving hollow shaft and arms partly perforated to admit the steam. Using hydraulic pressure in cleansing and filtering the saccharine solution after conversion, whereby a great saving is effected in the expense of the production of such sugar.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 19.—Medical, 8.

TUESDAY, 20.—Royal Institution, 3. Prof. Rutherford, M.D., "On Respiration."

— Civil Engineers, 8.

— Zoological, 8½.

— Anthropological 8. (Anniversary.)

WEDNESDAY, 21.—London Institution, 7.

— Meteorological, 7. (Anniversary.)

— Society of Arts, 8

— Geological, 8.

THURSDAY, 22.—Royal Institution, 3. Prof. P. M. Duncan, F.R.S., "On Palaeontology, with reference to Extinct Animals and the Physical Geography of their Time."

— Royal, 8½.

— Royal Society Club, 6.

FRIDAY, 23.—Royal Institution. Weekly Evening Meeting, 8.

— Royal Institution, 9. Prof. Sylvester, M.A., F.R.S., "On Recent Discoveries in Mechanical Conversion of Motion."

SATURDAY, 24.—Royal Institution, 3. Prof. G. Croom Robertson, "On Kant's Critical Philosophy."

Theoretical and Practical Chemistry.—

Mr. SIDNEY W. RICH, Analytical and Consulting Chemist, undertakes all kinds of Analyses, including the Analysis of Water, of articles of Food and Drink, and of Commercial Articles.

Mr. RICH also undertakes Investigations relating to Patents, Manufactures, &c. Gentlemen who wish to carry out Investigations personally may have a separate room if privacy be needed.

PRACTICAL CLASSES commence in October, January, and March, but laboratory pupils who work independently may enter at any time.

Further Particulars may be obtained at the Laboratory, 1A, CHIFFINIES STREET, TOTTENHAM COURT ROAD, LONDON, W.C.

THE CHEMICAL NEWS.

VOL. XXIX. No. 739.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 30).

The Weights.

A SET of weights as ordinarily supplied by even the best instrument-makers is never absolutely exact; however carefully they may be adjusted, the pieces of metal which respectively represent 1000 grs., 100 grs., 10 grs., &c., are only more or less approximations to the true weights. In most chemical analyses, the error arising from such inaccuracies in the weights used is so small, in comparison to errors of manipulation or to imperfections inherent in the chemical processes adopted, that it may generally be disregarded; but when the chemist has for his object the determination of an atomic weight, or is engaged in other researches demanding the highest refinement of accuracy which chemistry and physics can supply, then he is bound to neglect no correction which will increase the precision of the results. That chemists, whose well-trained reasoning powers allow them to take for granted nothing which is not capable of experimental verification, and who insist upon the utmost attainable precision in their balances, should, as a rule, neglect the probable errors which the inaccuracies of their weights may introduce, is somewhat inconsistent. But in considering these eliminations in my memoir, I must disclaim any originality in the process, the description of the method I employed being intended solely to place others on the same footing as myself in their judgment of the possible inaccuracies of my investigations and their effect on the result.

Professor W. H. Miller, of Cambridge, in his valuable researches on the determination of the standard pound (*Philosophical Transactions* for 1856, pp. 811, 827, 937), has given full directions for attaining a similar object. These, however, will not exactly apply to the systems of weights used by chemists; for, of the three cases described by him the former two concern a peculiar system of weights, and in the third, two sets of weights (one for the Exchequer, the other for the Royal Mint) were compared at the same time. To this paper, as well as to the learned author himself, I am indebted for a valuable store of information on the subject of weights and weighings.

The weights employed were of platinum, made expressly for these investigations by Messrs. Johnson and Matthey. The platinum was quite pure; it was fused, cast, and then well hammered. The weights were adjusted by myself during May, June, July, and August, 1864: they were first roughly adjusted, and then the specific gravity of each weight was taken. The weights were heated to redness in a bath of magnesia previous to ascertaining their specific gravity. The density of the larger weights was ascertained to the second place of decimals, and that of the smaller ones to the first place. The record of the final adjustment of these weights will be sufficient to show the method I adopted.

In taking the specific gravity of the weights, the distilled water was contained in a glass beaker of about 250 cubic inches capacity. Each weight was suspended by a fine platinum wire to be attached to the pan of the balance. With this wire affixed the weight was introduced into a small glass vessel filled with water, and heated over a spirit-lamp to the boiling-point. When all the air-bubbles had been expelled by this process, the small jar

containing the weight was lowered into the water in the beaker, the weight, on removing the small jar, being perfectly free from any adhering bubbles of air. After the temperature had sunk to the proper point, the specific gravity was taken.

The 1000-grain weight was selected as the standard: for in nearly every process in which weights are used in chemistry, the object is not to ascertain the *absolute* weight of a substance in terms of a grain or gramme, but to determine its *relative* weight in comparison with that which it possessed at some other time before it was submitted to certain analytical or synthetical operations. If the weighings are performed with the same weights, it does not at all matter whether the weights are absolutely of the same value which they profess to be; but it is very important that they should bear a known proportion to each other. This must be understood as referring only to ordinary chemical research in synthesis or analysis. In many physical investigations it is of great importance that the 1000-grain weight should really represent 1000 normal grains, or that its deviation from that value should be accurately determined; but I confess I do not know where a standard weight suitable for such a comparison is to be met with. The weights at first tried were far from accurate among themselves. I accordingly ascertained their errors by the method described below, and then adjusted them myself according to the corrections thus found necessary. The residual errors in the weights were then finally taken in the following manner:—

The balance being brought into equilibrium and the temperature and barometrical pressure carefully noted, the 1000-grain weight was placed in the left pan, and in the right the 600, the 300, and the 100-grain weights. It was now found that, to bring the balance back to equilibrium, a slight additional weight had to be placed on the right side to supplement the three weights already in that pan. This was noted. The weights were then removed to the opposite sides, the 1000 grains being on the right and the three smaller weights on the left. It was now found that a small weight had to be subtracted from the side carrying the three weights in order to produce equilibrium. The weights were removed and interchanged in this manner ten times, so as to eliminate, as far as possible, the errors arising from observation, or the unequal expansion by heat of the arms of the balance; and by applying the method of least squares to the results obtained, the following equation was arrived at:—

$(1000) = (600) + (300) + (100) + 0.01000 \dots a,$
the figures within parentheses representing the nominal value of the actual pieces of platinum stamped 1000, 600, 100 grains, &c.

In a similar manner the values of the remaining weights were ascertained; thus,—

$(600) = (300) + (200) + (100)$	$+ 0.00777 \dots b$
$(300) = (200) + (100)$	$+ 0.00991 \dots c$
$(200) = (100) + (60) + (30) + (10)$	$+ 0.01577 \dots d$
$(100) = (60) + (30) + (10)$	$- 0.00030 \dots e$
$(60) = (30) + (20) + (10)$	$- 0.00522 \dots f$
$(30) = (20) + (10)$	$+ 0.00154 \dots g$
$(20) = (10) + (6) + (3) + (1)$	$+ 0.00355 \dots h$
$(10) = (6) + (3) + (1)$	$+ 0.00052 \dots i$
$(6) = (3) + (2) + (1)$	$- 0.00102 \dots j$
$(3) = (2) + (1)$	$+ 0.00165 \dots k$
$(2) = (1) + (6) + (3) + (1)$	$- 0.00312 \dots l$
$(1) = (6) + (3) + (1)$	$- 0.00508 \dots m$
$(6) = (3) + (2) + (1)$	$- 0.00260 \dots n$
$(3) = (2) + (1)$	$+ 0.00225 \dots o$
$(2) = (1) + (6) + (3) + (1)$	$- 0.00100 \dots p$
$(1) = (6) + (3) + (1)$	$- 0.00802 \dots q$
$(6) = (3) + (2) + (1)$	$- 0.00607 \dots r$
$(3) = (2) + (1)$	$- 0.00642 \dots s$
$(2) = (1) + (6) + (3) + (1)$	$- 0.00118r' \dots t$
$(1) = (6) + (3) + (1)$	$+ 0.00413r' \dots u$
$(6) = (3) + (2) + (1)$	$+ 0.00410r'' \dots v$

* A Paper read before the Royal Society June 20, 1872.

* r' , r'' represent riders, two of which were adjusted in this manner.

We have now the data for ascertaining the absolute values of the weights in terms of the (1000) weight taken as standard. Adding the equations *a* and *b* gives—

$$(1000) = 2(300) + 2(100) + 0.01777.$$

Multiplying equation *c* by 2 gives—

$$2(300) = 2(200) + 2(100) + 0.01982.$$

Subtracting *c* from *d* gives—

$$(200) = 2(100) + 0.01607.$$

Now by $(a+b) + 2c + 3(d-e)$ we get—

$$(1000) = 10(100) + 0.01777 + 0.01982 + 0.04827;$$

$$\therefore (1000) = 10(100) + 0.08580;$$

$$\therefore \frac{(1000)}{10} = (100) + 0.008580;$$

$$\therefore (100) = 100 - 0.008580;$$

$$\therefore (100) = 99.991420 \text{ grains.} \quad . . . \text{ A.}^*$$

Substituting this value for the (100) weight, we get from equation *e*,—

$$99.991420 = (60) + (30) + (10) - 0.00030;$$

$$\therefore (60) + (30) + (10) = 99.991720. \quad . . . \text{ B.}$$

From equation *d* we therefore get—

$$(200) = 99.991420 + 99.991720 + 0.01577;$$

$$\therefore (200) = 199.998910. \quad . . . \text{ C.}$$

From equation *c* we get—

$$(300) = 199.998910 + 99.991420 + 0.00991;$$

$$\therefore (300) = 300.000240. \quad . . . \text{ D.}$$

From equation *b* we get—

$$(600) = 300.000240 + 199.998910 + 99.991420 + 0.00777;$$

$$\therefore (600) = 599.998340. \quad . . . \text{ E.}$$

Again, adding *e* and *f*,—

$$(100) = 2(30) + (20) + 2(10) - 0.00552;$$

\therefore from *A*,—

$$99.991420 = 2(30) + (20) + 2(10) - 0.00552.$$

Multiplying *g* by 2,—

$$2(30) = 2(20) + 2(10) + 0.00308.$$

Subtracting *i* from *h*,—

$$(20) = 2(10) + 0.00303.$$

By adding *e*, *f*, twice *g*, and thrice the last equation, we get—

$$99.991420 = 10(10) + 0.000665;$$

$$\therefore (10) = 9.998477. \quad . . . \text{ F.}$$

From equation *i* we get—

$$9.998477 = (6) + (3) + (1) + 0.00052;$$

$$\therefore (6) + (3) + (1) = 9.997957. \quad . . . \text{ G.}$$

Substituting these values in *h* we get—

$$(20) = 9.998477 + 9.997957 + 0.00355;$$

$$\therefore (20) = 19.999984. \quad . . . \text{ H.}$$

From *g* we get—

$$(30) = 19.999984 + 9.998477 + 0.00154;$$

$$\therefore (30) = 29.999991. \quad . . . \text{ I.}$$

From *f* we get—

$$(60) = 29.999991 + 19.999984 + 9.998477 - 0.00522;$$

$$\therefore (60) = 59.993232. \quad . . . \text{ J.}$$

Again, adding *i* and *j*,—

$$(10) = 2(3) + (2) + 2(1) - 0.00050.$$

Multiplying *k* by 2,—

$$2(3) = 2(2) + 2(1) + 0.00330.$$

Subtracting *m* from *l*,—

$$(2) = 2(1) + 0.00196.$$

Then $(i+j) + 2k + 3(l-m)$ gives—

$$(10) = 10(1) + 0.00868;$$

$$\therefore 9.998477 = (10) + 0.00868;$$

$$\therefore 0.9998477 = (1) + 0.000868;$$

$$\therefore (1) = 0.9989797. \quad . . . \text{ K.}$$

From equation *m* we have—

$$0.9989797 = (6) + (3) + (1) - 0.00508;$$

$$\therefore (6) + (3) + (1) = 1.0040597. \quad . . . \text{ L.}$$

From *l*,—

$$(2) = 0.9989797 + 1.0040597 - 0.00312;$$

$$\therefore (2) = 1.9998394. \quad . . . \text{ M.}$$

From *k*,—

$$(3) = 1.9998394 + 0.9989797 + 0.00165;$$

$$\therefore (3) = 3.0004691. \quad . . . \text{ N.}$$

From *j*,—

$$(6) = 3.0004691 + 1.9998394 + 0.9989797 - 0.00102;$$

$$\therefore (6) = 5.9982682. \quad . . . \text{ O.}$$

Again, adding *m* and *n*,—

$$(1) = 2(3) + (2) + 2(1) - 0.00768.$$

Multiplying *o* by 2 we get—

$$2(3) = 2(2) + 2(1) + 0.00450.$$

Subtracting *q* from *p*,—

$$(2) = 2(1) + 0.00702.$$

Then $(m+n) + 2o + 3(p-q)$ gives—

$$(1) = 10(1) + 0.01788;$$

$$\therefore 0.9989797 = 10(1) + 0.01788;$$

$$\therefore 0.09989797 = (1) + 0.001788;$$

$$\therefore (1) = 0.09810997. \quad . . . \text{ P.}$$

From *q* we get—

$$0.09810997 = (06) + (03) + (01) - 0.00802;$$

$$\therefore (06) + (03) + (01) = 0.10612997. \quad . . . \text{ Q.}$$

From *p*,—

$$(2) = 0.09810997 + 0.10612997 - 0.00100;$$

$$\therefore (2) = 0.20323994. \quad . . . \text{ R.}$$

From *o*,—

$$(3) = 0.20323994 + 0.09810997 + 0.00225;$$

$$\therefore (3) = 0.30359991. \quad . . . \text{ S.}$$

From *n* we get—

$$(6) = 0.30359991 + 0.20323994 + 0.09810997 - 0.00260;$$

$$\therefore (6) = 0.60234982. \quad . . . \text{ T.}$$

Again, adding *q* and *r*,—

$$(1) = 2(03) + (02) + 2(01) - 0.01409.$$

Multiplying *s* by 2 we get—

$$2(03) = 2(02) + 2(01) - 0.01284.$$

Subtracting *u* from *t*,—

$$(2) = 2(01) - 0.00531.$$

Then $(q+r) + 2s + 3(t-u)$ gives—

$$(1) = 10(01) - 0.04286,$$

$$\therefore 0.09810997 = 10(01) - 0.04286,$$

$$\therefore 0.009810997 = (01) - 0.004286,$$

$$\therefore (01) = 0.014096997. \quad . . . \text{ U.}$$

From *u* we get—

$$0.014096997 = (01r') + 0.00413,$$

$$\therefore (01r') = 0.009966997. \quad . . . \text{ V.}$$

From *t* we get—

$$(02) = 0.014096997 + 0.009966997 - 0.00118,$$

$$\therefore (02) = 0.022883994. \quad . . . \text{ W.}$$

From *s* we get—

$$(03) = 0.022883994 + 0.014096997 - 0.00642,$$

$$\therefore (03) = 0.030560991. \quad . . . \text{ X.}$$

From *r* we get—

$$(06) = 0.030560991 + 0.022883994 + 0.014096997 - 0.00607,$$

$$\therefore (06) = 0.061471982. \quad . . . \text{ Y.}$$

From *v* we get—

$$0.014096997 = (01r') + 0.00410,$$

$$\therefore (01r') = 0.009996997. \quad . . . \text{ Z.}$$

The value of the weights thus given was, however, their weight in *air* of the ordinary pressure; it became therefore necessary to ascertain their value in a vacuum. All bodies displace a bulk of air equal to their own volume, and the weight of this air is of course greater as their specific gravity diminishes. In delicate investigations this loss of weight is important. The reduction of the platinum weights to their true value *in vacuo* I calculated by the following formula:—

Let *W* = weight in air,

w = " " water,

a = specific gravity of air as compared with water;

then—

$$x, \text{ or weight in } vacuo, = \frac{W - aw}{1 - a},$$

* Although these decimals are carried to the sixth place, the balance would not indicate beyond the fourth place. By taking the mean of ten interchanged weighings, I could obtain a fifth place. The calculated values of the weights were carried to a sixth decimal, in order to avoid inaccuracy in the fourth and fifth places when several values were summed.

where—

$$a = 0.001225, \text{ and} \\ 1 - a = 0.998775.$$

The following table shows the final results of these adjustments:—

Nominal Value of Weights.	True Value in Air at 30 in.* 62° F.	Weight of Air Displaced.	Volume in Water of Maximum Density.
Grs.	Grs.	Grs.	Grs.
1000.00	1000.000000	0.058271	47.5100
600.00	599.998340	0.035533	28.9700
300.00	300.000240	0.017501	14.2700
200.00	199.998910	0.011664	9.5100
100.00	99.991420	0.005887	4.8000
60.00	59.993232	0.003483	2.8400
30.00	29.999991	0.001668	1.3600
20.00	19.999984	0.001104	0.9000
10.00	9.998477	0.000490	0.4000
6.00	5.998268	0.000355	0.2900
3.00	3.000469	0.000171	0.1400
2.00	1.999839	0.000113	0.1000
1.00	0.998980	0.000055	0.0400
0.60	0.602350	0.000035	0.0300
0.30	0.303600	0.000017	0.0200
0.20	0.203240	0.000011	0.0100
0.10	0.098110	0.000005	0.0040
0.06	0.061472	0.000003	0.0030
0.03	0.030561	0.000002	0.0020
0.02	0.022884	0.000001	0.0010
0.01	0.014097	0.000001	0.0004
0.01'	0.009997	0.000001	0.0004
0.01''	0.009967	0.000001	0.0004

The value of each weight in air, *plus* the weight of air displaced, is, of course, the weight *in vacuo*.

Having ascertained their true value, the weights were carefully preserved; and as, being of platinum, there was no accumulation of tarnish on their surface, and as they were lifted with ivory-tipped forceps to prevent wear, they have showed up to the present time, whenever compared, absolutely no alteration.

(To be continued.)

ON CYMENE AS A CONSTITUENT OF, AND DERIVATIVE FROM, OIL OF TURPENTINE.

By C. R. A. WRIGHT, D.Sc.

On Feb. 6, 1873, the writer read before the London Chemical Society a paper (CHEMICAL NEWS, vol. xxvii., p. 82; *Journ. Chem. Soc.*, [2], xi., 549) wherein it was shown that there are reasons for supposing that the small quantities of terephthalic acid obtained by the oxidation of certain terpenes are really derived, not from the terpene itself, but from cymene simultaneously present; and it was moreover stated that cymene had been actually isolated from two such terpenes (*viz.* myristicene from nutmeg oil and terebenthene from oil of turpentine) by a process suggested to the writer by Dr. Hugo Müller, *viz.*, "treating the mixture with sulphuric acid so as to polymerise the terpene present, and then diluting with water, and distilling in a current of steam."

Shortly after (April 3, 1873), the writer read a second paper describing the properties of the cymene thus obtained, and contrasting them with those of cymene from other sources (CHEMICAL NEWS, vol. xxvii., p. 180; *Journ. Chem. Soc.* [2], xi., 686).

On Feb. 21, 1873, M. Ribau communicated to the Paris Chemical Society the results of his experiments on the action of sulphuric acid on terebenthene (*Bul. Soc. Chem. Paris*, xix., 242), and on July 4, 1873, he also read another paper on the same subject (*Ibid.*, xx., 97 and 100), the result arrived at being that cymene is found from the terpene by the reaction $C_{10}H_{16} + H_2SO_4 = 2H_2O + SO_2 + C_{10}H_{14}$.

* The cistern of the barometer is 115 feet above the approximate mean water-level at Somerset House.

In a postscript to the second of the above mentioned papers, written before the appearance of M. Ribau's second communication, the writer suggested that the cymene obtained by M. Ribau was not formed thus, but was that pre-contained as such, the main reason given being that by cautiously acting on oil of turpentine with sulphuric acid, "the writer had succeeded in isolating cymene from oil of turpentine, without the evolution of more than inconsiderable quantities of sulphurous acid." The method employed was as follows:—Oil of turpentine freed from oxidised substances by distillation over sodium was very gradually mixed with about its own weight of sulphuric acid, the mixture being carefully cooled; after a few minutes the whole was poured into a large bulk of water, the oily layer decanted and distilled with water, and the oily layer of distillate treated repeatedly in the same way. Only once or twice was a very faint odour of sulphurous acid observed; and, as about 3 per cent of nearly pure cymene was ultimately obtained (irrespective of losses and waste in distillation), it was inferred that this was pre-contained as such.

It being in no way improbable that some specimens of oil of turpentine might contain more cymene than others, the pre-existence of M. Ribau's cymene thus appeared exceedingly probable, even though the amount obtained by this chemist was considerably above 3 per cent.

Between August 20, and September 1, 1873, Herr Orlewski read before the Meeting of Russian Naturalists, at Kasan, a paper, in which he states (as reported by Richter, *Ber. Deut. Chem. Ges.*, vi., 1257), that considerable quantities of cymene are produced by the action of sulphuric acid on turpentine oil in the ordinary process for preparing terebene; and that terebene itself is altered by this reagent, cymene being formed, sulphurous acid being simultaneously generated. At the same time Herr Orlewski stated, that by long continued fractional distillation of an old yellowish sample of turpentine oil, he succeeded in isolating a small percentage of cymene (10 grammes from 1½ litres), and ascribed the presence of this substance to the action of atmospheric oxygen on the original oil, whereby hydrogen is removed from the terpene.

As regards this explanation, the writer has shown (*loc. cit.*) that by the action of oxidising agents, certain terpenes undergo the reaction, $2C_{10}H_{16} + O_2 = 2C_{10}H_{16}O$, the resulting bodies presenting great similarity to certain isomerides of camphor which readily break up by treatment with dehydrating agents into cymene and water, $C_{10}H_{16}O = H_2O + C_{10}H_{16}$. M. Ribau has very recently published in the *Bulletin* of the Paris Chemical Society (January 5, 1874, pp. 3, 4) two notes, the one a reclamation for priority over Herr Orlewski, the other a discussion of the reasons assigned by the writer for supposing that the cymene obtained by M. Ribau was pre-contained as such.

As regards the first question, a comparison of the above dates will show that, whilst M. Ribau undoubtedly preceded Herr Orlewski in this matter by several months, the results of the writer were made public in London, more than a fortnight before those of M. Ribau were first brought before the notice of Parisian chemists; it is therefore evident that, whilst the experiments of M. Ribau and the writer must have been carried on almost simultaneously, the actual claim to priority rests with England rather than with France or Russia.

As regards the second point, the writer has great pleasure in confirming the exactitude of M. Ribau's results; whilst he has no doubt from his own results (and those of Herr Orlewski) that cymene is actually pre-contained in, at any rate, some specimens of oil of turpentine; and in other terpenes he has yet found that when the action of the sulphuric acid is prolonged for some hours at the ordinary temperature (and especially if the mixtures be made quickly so as to heat rapidly), sulphurous acid is copiously given off, and a much larger quantity of cymene is obtainable than can be if all possible care and precautions are taken to avoid the formation of

sulphurous acid; this additional quantity must necessarily be found, as M. Ribau first suggested, by the reaction $C_{10}H_{16} + H_2SO_4 = 2H_2O + SO_2 + C_{10}H_{14}$.

Chemical Laboratory, St. Mary's Hospital, W.
Jan. 11, 1874.

THE CHEMICAL CONSTITUTION OF CITRIC ACID AND ITS NUMEROUS DERIVATIVES,

CRITICALLY EXAMINED AND INTERPRETED FROM THE STANDPOINT OF THE "TYPO-NUCLEUS" THEORY.

By OTTO RICHTER, Ph.D.

THIS paper is a continuation of my researches into the molecular structure of that particular class of organic water-salts which derive from the olefine-begotten poly-atomic alcohols. It is by a train of reasoning similar to what I pursued when treating on the heterologues of the tri- and tetratomic alcohols that I shall next endeavour to expound the molecular changes which, in the living organism, are supposed to attend the slow and gradual combustion of the penta- and hexatomic alcohols. And here the proper treatment of my subject demands that I should draw into the circle of the present enquiry another and, to judge from its saturating capacity, a strictly tetratomic alcohol.

Let us first of all understand that, with one single exception, all the parent alcohols of the two schemes that precede, and the three schemes that follow, occupy the *first* place in their respective series, whence their principals are represented by a molecule of *methylic* ether, whereas the exceptional parent alcohol, viz., the tetratomic amylen erythrol, occupies the *second* place in the series, whence its principal is represented by a molecule of *ethylic* ether. Owing to the vast number of heterologues that each parent alcohol is capable of producing, I have been obliged to resort to the device of a "general guide," and by excluding from my schemes the de-alcoholic and monobasic derivatives, I have been enabled to construct for the first and second scheme a list of all the theoretically possible bibasic water-salts, and for the third scheme a similar list of all the theoretically possible tribasic water-salts.

These points being settled, I shall now proceed to acquaint the reader with the leading topics of my programme, which consists of two parts. In the first part, I shall elucidate the molecular changes that accompany the artificial production of certain bibasic and tribasic water-salts, identical with or closely related to the water-salts of pyro-tartaric, pyro-citric, and citric acids. In the second part, I shall contemplate the effects of heat on the ordinary citrate of water, as also the effects of oxidising and reducing agents on the three pyro-citric isomerides. After these preliminaries, I shall at once direct the reader's attention to the contents of the first part.

PART I.

On the Principal Molecular Changes that accompany the Artificial Production of certain Bibasic and Tribasic Water-Salts, identical with or closely related to the Water-Salts of Pyro-Tartaric, Pyro-Citric, and Citric Acids.

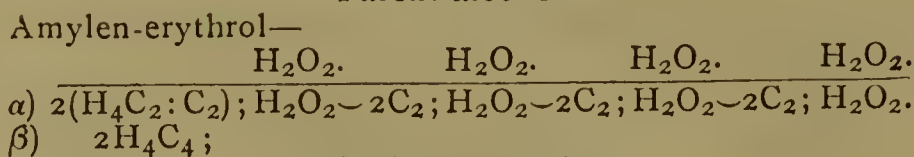
It is necessary that I should inaugurate the discussion with a representation of the three schemes above alluded to. These schemes are composed of a network of chemical formulæ, which form the theoretical basis of reasoning, and to which I shall have frequent occasion of referring in the sequel. As to their proper use and meaning, the reader is requested to consult the explanatory note at the close of the preceding paper.

GENERAL GUIDE.

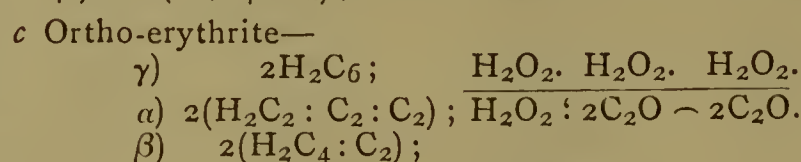
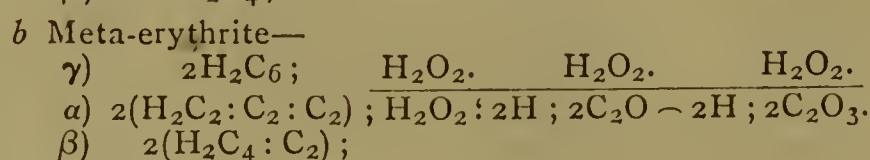
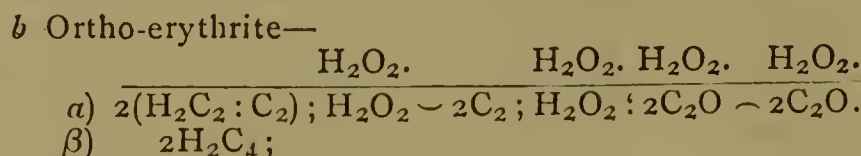
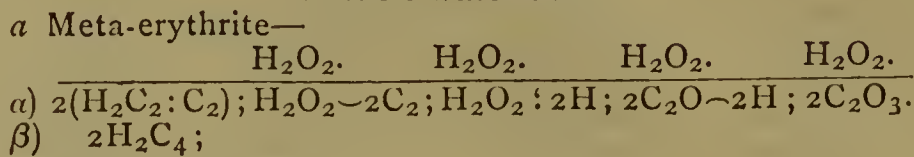
Water-salts.		Affixes.				
		-ite.	-éite.	-ate.	-éate.	-oate.
Bibasic	Meta series	1-3	3-3	3-5	5-5	—
	Ortho series	1-1	1-3	3-3	3-5	—
Tribasic	Meta series	1-1-3	1-3-3	1-3-5	3-3-5	3-5-5
	Ortho series	1-1-1	1-1-3	1-3-3	3-3-3	3-3-5

FIRST SCHEME. Tetratomic System.

Parent alcohol:

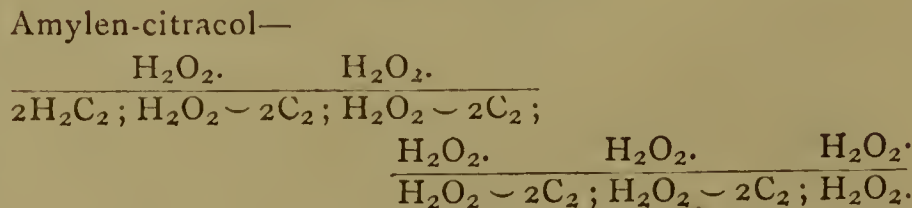


Bibasic water-salts:

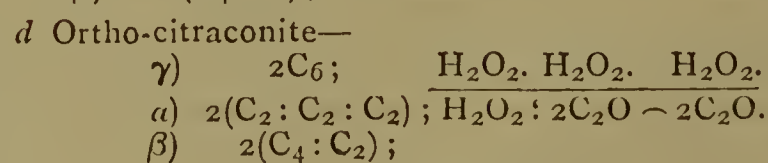
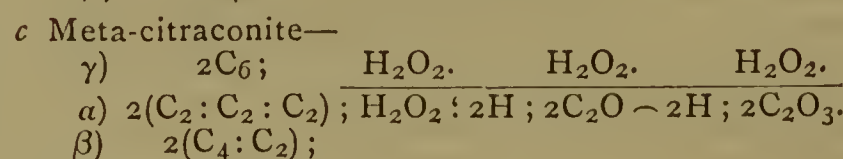
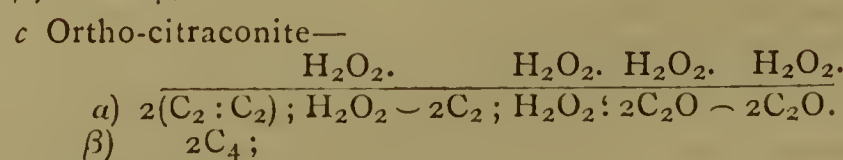
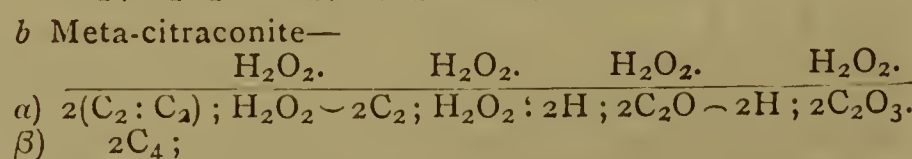
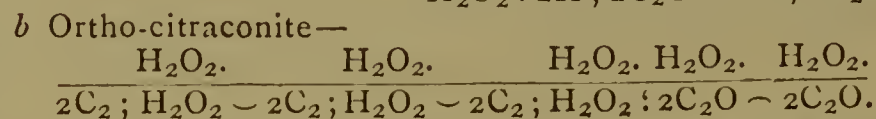
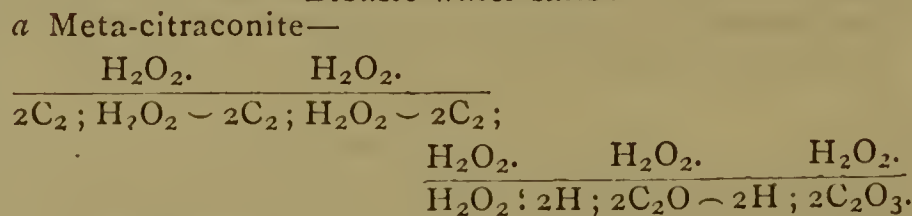


SECOND SCHEME. Pentatomic System.

Parent alcohol:

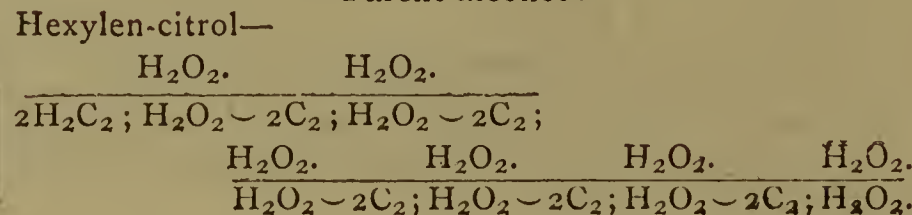


Bibasic water-salts:



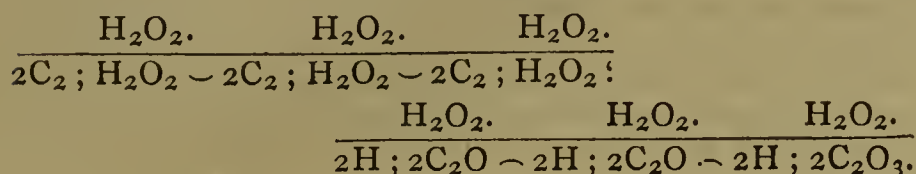
THIRD SCHEME. Hexatomic System.

Parent alcohol:

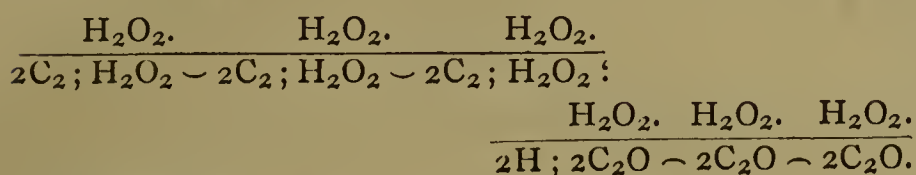


Tribasic water-salts :

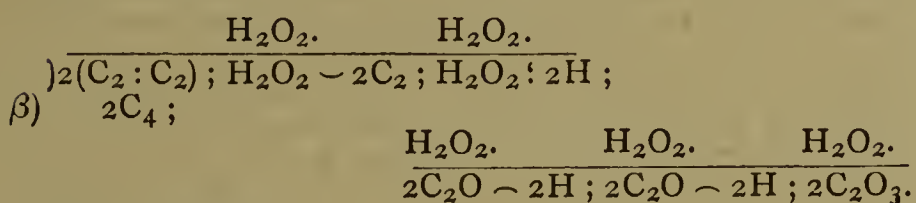
a Meta-citrite—



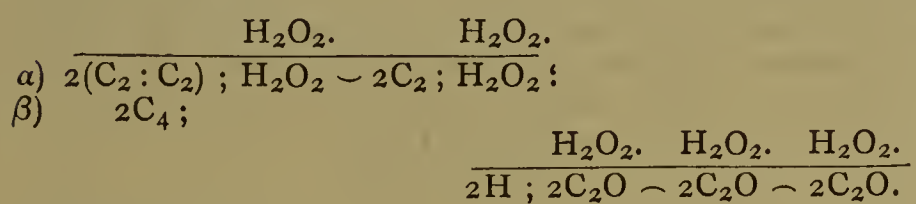
b Ortho-citrite—



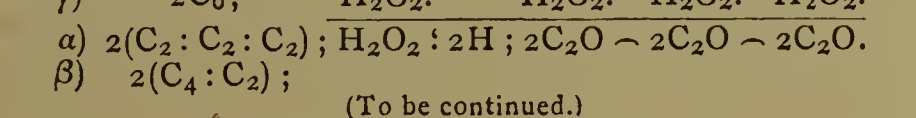
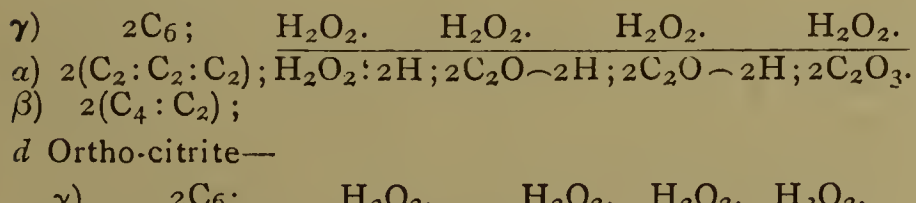
Meta-citrite—



c Ortho-citrite—



c Meta-citrite—



(To be continued.)

EVOLUTION AS APPLIED TO THE CHEMICAL ELEMENTS.

By WILLIAM H. WOOD.

IN *Nature* of November 6th Mr. C. T. Blanshard attempts "to explain the close connection that holds between certain of the so-called elements," by means of the hypothesis of evolution. Mr. B. mentions what (he considers) are the chief grounds for holding that the theory explains this connection, and he leaves "the examination into its truth or falsity in the hands of more experienced chemists." As no criticism of Mr. B.'s note by "more experienced chemists" has yet appeared,—though a note by Mr. C. T. Kingzett, calling attention to the fact that similar views have been already made public by himself and others appeared in a recent issue (*CHEMICAL NEWS*, vol. xxviii., p. 288),—perhaps one who does not lay claim to that title may be allowed to make a few remarks upon it.

It is very necessary that Mr. B. should make correct statements of "the close connection" in question, otherwise his application of the theory of evolution to explain it is worse than useless, because it is simply an explanation of something which does not exist, and may lead some astray. At present I shall content myself with endeavouring to make clear that "the close connection" is not such as Mr. B. states.

The natural group containing the alkaline metals, lithium, sodium, potassium, rubidium, and caesium, is referred to, and, amongst others, this statement is made:—"To the principle that lighter atoms have greater polarity or chemical affinity, Bunsen has found an exception, that caesium is heavier, and yet more electro-positive, than potassium or sodium." The order, then, in this group is (according to Mr. B.) that Li, having a lighter atom, has greater polarity or chemical affinity, or is more electro-

positive than Na, Na for the same reason more than K. and that this holds generally in groups; but in this group Cs is the single exception—admitted by Mr. B. on Bunsen's authority. Is this really the case? All the chemical authorities I can consult—Gmelin, Miller, Frankland, Odling, Naquet, and others—agree in their statements as to the facts embodied in the following table:—

	Order of Polarity, Chemical Affinity, or Electro-positiveness.	Atomic Weight.	Fusing-Point. ° C.	Atomic Heats.	Specific Heats.
Lithium ..	1. Lowest	7.0	180.0	6.58	0.940
Sodium ..	2.	23.0	97.6	6.75	0.293
Potassium	3.	39.1	62.5	6.61	0.169
Rubidium	4.	85.3	38.5	—	—
Cæsium ..	5. Highest	133.0	—	—	—

It appears, from this table, that the rule as regards this group is just the opposite to what Mr. B. lays down, the chemical affinity *increasing* as the atom becomes heavier.

Another statement, made under the head of "Heat," is, that "with the elements taken according to natural groups, the greater the atomic weight the higher the fusing or boiling-point." This statement, tested by the above table, does not hold so far as it concerns the fusing-points of the first four elements of the group; it is, in fact, just the reverse. Arsenic, antimony, and bismuth are cited in the paper as examples bearing out this statement, but it does not appear that they do so, their fusing-points being As (atomic weight 75), "between the melting-points of antimony* and silver"† (Mallet),‡ under pressure; Sb about 1150° F. (Miller), and Bi 507° F. (Rudberg). The same being the case with mercury, cadmium, and zinc, as Mr. B. admits, renders the statement a rather doubtful one.

Then it is stated that there is a "lessening of the atomic heat, with increase of mass" (the mass being here the atomic weight), but this is not borne out in the case of Li, Na, and K; the atomic heat of Na being (as will be seen from the table) higher than that of Li; and even that of K, though less than that of Na, is higher than that of Li. How does Mr. B. account for these discrepancies between the facts and his statements?

Another group to which reference is made is that of the *Halogens*, chlorine, bromine, and iodine. Here it appears that the rule the greater the atomic mass and the less the affinity holds, as also that referring to the fusing and boiling points; when we compare the atomic heats, however, we find that that of I is higher (6.87) than that of Br (6.74), instead of being lower, as according to Mr. B. it should be. Perhaps this may appear to be the rule to Mr. B. if he is content with such inaccurate statements as that the atomic weight of Br is 81. It appears likely Mr. B. has written *atomic heat* instead of *specific heat*; if so, the amended statement may be correct.

In comparing the *alkaline metals* and the *Halogens*, Dr. Miller makes the following pertinent remarks ("Chemistry," vol. ii., p. 337):—"In treating of the groups of the non-metallic and electro-negative elements, it has been remarked that the electro-negative character of those belonging to the same group is most strongly marked in those which have the lowest combining number—chlorine, for example, being more active than bromine, and bromine than iodine. With the basylous or electro-positive elements the reverse generally holds good; the basic power of rubidium, for example, being greater than that of potassium, that of potassium greater than that of sodium, and that of sodium being superior to the basic power of lithium."

We are told that "It is only with the more specialised of the metals, those which we have seen have massive atoms, that hydrogen will unite, viz., antimony and

* Sb melts about 1150° F. (Miller).

† Ag melts at 1873° F. (Daniell).

‡ *CHEMICAL NEWS*, vol. xxvi., p. 97.

arsenic; and the compound it forms with the former is very unstable." Now the atomic weight of Sb is 122, that of As 75. The atom of the latter is certainly not massive, comparatively speaking, and that of Sb not particularly so. Mr. B. does not show that SbH_3 is more unstable than AsH_3 , and if, as we find it stated, both these compounds require exposure to nearly a red heat to decompose them, the "very unstable" nature of SbH_3 does not seem to be proven. Copper (atomic weight 63.5) forms a compound with hydrogen, Cu_2H_2 , in addition to Sb and As, but the atom of Cu is not massive, though, if Mr. B. is to be believed, it is one of "the more specialised metals," and this combination shows its "comparatively non-metallic nature."

"Hydrogen" is stated to have "the greatest conducting power of all gases"—*for heat* is to be understood from the heading of the section. The experiments made on this point have been to compare the relative cooling effect of air and hydrogen on platinum wire heated to redness by an electric current. The luminosity of the wire is found to be diminished most by the hydrogen. The cooling effect may, however, be attributed to other things as well as to conduction, Tyndall attributing it to the greater mobility of the hydrogen particles, while Magnus favours conduction.

The points enumerated are the more important ones to which I take objection, or call in question. Though I do so, I am not unwilling—nor, I believe, are chemists generally—to consider the application of the theory of evolution, or any other, to explain the relations really known to exist among the chemical elements, since observation from new standpoints frequently results in more truthful views being gained, and thus the domain of scientific truth is gradually contended.

Halifax, Dec. 22, 1873.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, January 15, 1874.

Dr. ODLING, F.R.S., President, in the Chair.

THE minutes of the previous meeting having been read and confirmed, Dr. Tommasi, and Messrs. Charles L. Field, J. L. Player, and Edward Collens were formally admitted Fellows of the Society.

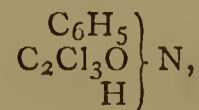
The donations were then announced, including a Chinese translation of the article "Gunpowder" from Watts and Richardson's "Technology," and the following names were read for the first time:—Messrs. John George Lyon, Francis J. W. Polglase, Magnus Ohren, Harry Grimshaw, William Carleton Green, Henry Tanner, Colonel William Boyle, Thomas Carnelly, B.Sc., and Alexander H. Sexton.

For the third time—Messrs. Frederick E. Harman, William Herbert Pike, Robert Frazer Smith, Henry Bowman, Joseph Reddross, R. L. Taylor, William Joseph Spratling, Dr. J. Lawrence Smith, and Owen Davies Owen, who were ballotted for and duly elected.

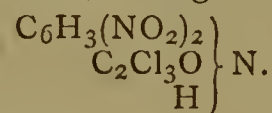
Mr. W. C. ROBERTS handed in a table supplementary to his paper read at the last meeting, and containing complete analyses of all the standard trial-plates still extant, dating from A.D. 1477—namely, seventeen gold plates and fourteen silver ones.

The first paper, "*On the Action of Trichloracetyl Chloride on Amines (I., Action on Aniline)*," by D. TOMMASI and R. MELDOLA, was read by the latter. After noticing the various bromine and chlorine derivatives of phenyl acetamide which had hitherto been obtained, the authors give details of the process—a modification of Gal's—by which the trichloroacetic acid was prepared from chloral hydrate

by the action of fuming nitric acid. The trichloroacetyl chloride was obtained from the acid by means of phosphorus trichloride. Aniline, when added to excess of the chloride, causes great elevation of temperature, and, on further application of heat, hydrochloric acid is given off, and the liquid assumes a dark brown colour. On cooling, it solidifies to a crystalline mass of phenyl trichloroacetamide—



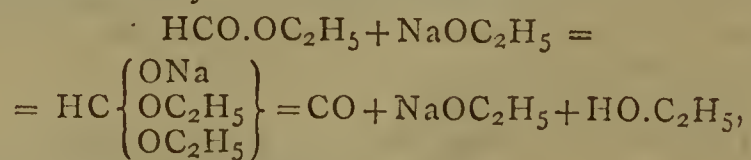
which is washed with water, and crystallised from hot alcohol. The new amide forms small lustrous rhomboidal plates, which melt at 94°C . It is soluble in benzene, and very soluble in carbon disulphide, ether, and chloroform. Boiled with caustic soda, the amide is decomposed, with formation of a basic substance of penetrating odour. The action of alcoholic ammonia appears to produce the same substance. The amide dissolves in cold fuming nitric acid, but the solution rapidly becomes hot, and evolves nitrous fumes in abundance; on boiling the mixture a short time, and then pouring the product into water, a substance is obtained which crystallises from hot alcohol in tufts of yellow needles, having the composition—



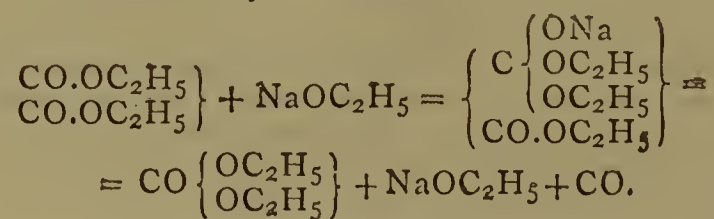
Dinitro-phenyl trichloroacetamide fuses at 118°C ., and does not explode when strongly heated. It is very slightly soluble in water, readily in benzene, ether, chloroform, and cold dilute alkaline solutions, from the latter of which it is precipitated unaltered on the addition of an acid; when the alkaline solution is boiled, decomposition ensues.

The PRESIDENT said the thanks of the Society were due to Dr. Tommasi and Mr. Meldola for their interesting communication. There was one point, however, in the preparation of the amide about which he would like to make an enquiry; that was, as to whether it was absolutely necessary to use the chloroacetyl chloride, or whether chloroacetic acid itself would not produce the body; it was well known that in many instances aniline, when heated with the acid, gave the corresponding amide.

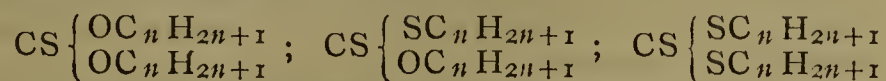
Dr. H. E. ARMSTRONG then read a "*Note on the Action of Sodid Ethylate on Ethylic Oxalate and other Etheral Salts*." Dittmar and Cranston have shown that, when ethylic oxalate is warmed with sodic or potassic ethylate, it is in great part resolved into carbonic oxide and ethylic carbonate. Very nearly equal molecular weights of these two products are obtained, the conclusion being that the reaction was a so-called catalytic one, *i.e.*, a cycle of reactions in which the ethylate is continuously decomposed and reproduced, and that a given weight of ethylate could decompose an unlimited quantity of oxalate, if it were possible to exclude certain other reactions which go on simultaneously with the principal one and gradually consume the ethylate. Geuther, again, has shown that ethylic formate is converted into carbonic oxide and ethylic alcohol under similar circumstances. Dr. Armstrong suggests that these decompositions may readily be explained, if we assume that the ethylate first combines with the etheral salt, and that the compound thus formed is afterwards broken up on heating; for instance, the reaction with ethylic formate would be—



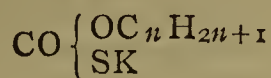
and in the case of ethylic oxalate—



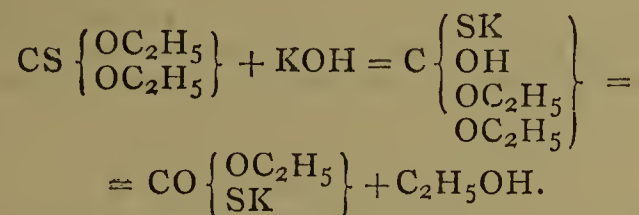
The same interpretation may be given of the decomposition of the ethereal salts of the form—



by potassium hydrate dissolved in alcohol, all of which, as Salmon has recently shown, yield compounds of the form—



Thus—



Professor ODLING, when thanking the author, said that, *prima facie*, it appeared to him that the nature of the reaction was most probably that suggested by Dr. Armstrong.

The last paper, "*On the Products of Decomposition of Castor Oil (No. I., Sebasic Acid)*," was read by the author, Mr. E. NEISON. The action of heat on sodium ricinoleate, obtained by treating castor oil with an equal weight of sodium hydrate, produces crude sodium sebate. The acid may be separated from this in the pure state by two methods detailed by the author. It forms feathery crystals or brilliant laminae, soluble in 1500 parts of water at 10°, and in 22 parts at a boiling heat; it is readily soluble in alcohol and ether. It is not decomposed by boiling with nitric acid for a few hours, nor by digestion with potassic dichromate and sulphuric acid. Of the two classes of salts formed by sebasic acid, the neutral would appear to be the most stable. The author has prepared and analysed many of these, including potassium hydrogen sebate, potassium sebate, sodium hydrogen sebate, sodium sebate, two barium sebrates, two strontium sebrates, two calcium sebrates, two magnesium sebrates, zinc sebate, aluminium hydrogen sebate, cobalt, nickel, lead, and copper sebate, mercurous sebate, mercuric sebate, and silver sebate.

The PRESIDENT thanked the author for his contribution to our knowledge of this acid, which was to be welcomed, as it formed almost the last known acid of the series, and could be obtained so readily from castor oil.

Mr. NEISON, in reply to questions by Dr. MILLS and Dr. WRIGHT, said that it was only his first paper on the subject, containing a description of the acid and its salts. Nitric acid did not change sebasic acid if boiled with it for several hours.

The meeting was finally adjourned until Thursday, Feb. 5, when there will be a paper, "*On the Action of Benzyl Chloride on Camphor*," by Dr. D. Tommasi.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, December 16th, 1873.

E. W. BINNEY, F.R.S., F.G.S., Vice-President, in the Chair.

MR. JAMES HEELIS was elected an Ordinary Member of the Society.

The CHAIRMAN said that since the last meeting the Society had lost one of its most illustrious members by the death of Professor Louis Agassiz, the great naturalist, who had been an Honorary Member for above thirty years. He (the Chairman) had the honour of being personally acquainted with the deceased, having been brought into communication with him during the publication of his great work, "*Recherches sur les Poissons Fossiles*," and having had the pleasure of supplying him with specimens for its illustration. In the Royal Society's Catalogue is a list of 130 scientific memoirs he gave to the world. The reputation of Agassiz as one of the foremost men of his day in natural history is too well known to

need any tribute from me, but after a lapse of thirty years his amiable manners and his great kindness in cheerfully imparting his vast stores of knowledge to the humblest student are fresh in my memory. He was one of the kindest and heartiest of men, and his fine and manly countenance at that time was the picture of health and good nature, and truly reflected the genial soul within. In great and small matters he was equally punctual and correct. All who ever allowed him to make use of their specimens must well remember the ample acknowledgments he made and the scrupulous care with which they were returned, and some of the first living palæontologists might learn a useful lesson in this respect from the illustrious dead. With Agassiz it may be truly said that it was hard to decide whether his head or his heart most deserved our admiration. The world has to lament the death of a great and good man, and this Society one of its greatest ornaments.

"*Method of Construction of a New Barometer*," by J. P. JOULE, D.C.L., LL.D., F.R.S., &c., President.

The condition of the instrument placed on March 18 in the Society's Hall proves that it is possible to use sulphuric acid on the top of the mercurial column without chemical action taking place. I have therefore proceeded to prepare other tubes with a view to test, by practical work, the merits of the new contrivance.

A tube of about 3-16th inch bore is selected. It is first cleaned by drawing a knotted string through it. It is then bent to the syphon shape, and near the longer end it is drawn to a capillary tube. It is then washed with nitric acid, afterwards with sulphuric acid. The sulphuric acid is then drained off. Mercury is then poured into the short limb. The end of the longer limb is then attached to my mercurial exhauster. On working this, the mercury rises in the tube, and, being replenished by pouring it into the short limb, soon arrives at the height due to the atmospheric pressure. It carries with it the acid left adhering to the sides, so that, after a few hours, half, or, what is better, one-third, of an inch of acid stands above the mercury. Small bubbles of air are seen to arise, but, by leaving the tube in connection with the exhauster for a day or two, these finally cease. Mercury is then poured into the short limb until that in the longer rises nearly to the capillary part of the tube. This is then sealed and detached from the exhauster. Mercury is then removed from the shorter limb until it stands in the long one at a convenient height. Sulphuric acid is then introduced into the short limb until it forms a column equal to that in the longer limb. A small tube is finally attached to the short limb, and dipping a little way into a small bottle containing a small quantity of sulphuric acid, prevents the access of moist air into the short limb.

The tube thus completed possesses the following advantages:—1. There is the utmost facility in the movement of the column, so that the most minute changes of pressure are at once registered without any dragging. 2. The depression produced by capillary action is reduced to one-half, so that the syphon arrangement can be satisfactorily used as affording an accurate neutralisation of capillary action.

Mr. BROTHERS exhibited the plates forming the first part of the Holborn Society's photolith reproduction of Hans Burgman's "*Triumphs of Maximilian I.*" The designs are engraved on wood and printed on separate sheets, but the set shown were mounted so as to exhibit the artist's intention—that of a triumphal procession. This remarkable work is considered to be one of the finest specimens of wood-engraving.

Mr. BAXENDELL read the following letter from Professor C. PIAZZI SMYTH, F.R.S., Astronomer-Royal of Scotland:—

Referring (as the prompt and frequent publications of your Society so easily and agreeably enable one to do) to Professor Osborne Reynolds's triumphant proof, on November 18, that his glass tubes were strong enough to act as guns,—and also that 1.5 inches depth of powder produced nothing like the force exerted by the electrical discharge,

and that that electrical discharge acted by means of conversion of water suddenly into steam, as when lightning rends a tree,—may I beg to offer two remarks?

1. The soundness of the discussions before the Society on the recent wood-struck case near Manchester is evident by a similar conclusion arrived at by the British Association when at Edinburgh in 1850; for a tree in the neighbourhood having been struck and specially shattered into thin plates of wood, during the week of congress, was formally examined by a deputation of the Association, and the lightning was held to have exploded the watery matter of the sap-vessels.

2. That water is a far more powerful exploder than gunpowder, if you can get it (the water) to explode at all, is now experimentally proved by Professor Osborne Reynolds's electrical experiments, and did occupy my attention many years ago, on comparing the far larger increase of space occupied by exploded water in the shape of steam than by exploded gunpowder in the shape of its permanent gases.

The difficulty, however, is to get the water to explode, and not to pass off merely into steam—a difficulty well illustrated by any and every accession of dampness to gunpowder fired in the usual way decreasing, instead of increasing, the gunpowder's explosive force.

In order to try to explode water, at that time, I melted a large ladle full of lead, put upon the fluid and almost red-hot surface a drop of water, and tried various devices to bring it under the influence of the heat; but, even when forcibly attempted to be pushed under the melted lead, the water ran with vehemence up the substance of the wooden probe employed, and refused to have anything to do with the fluid lead, which consequently remained undisturbed.

But when I next took a smaller iron ladle, put a drop of water on the bottom of it, and gave therewith a little pat to the surface of the melted lead, instantly the whole contents of the great ladle were scattered to the winds, and only a few grains were recovered. Explosion of water had apparently taken place with excellent effect.

Then came a question as to repeating such an explosion at small intervals of time in a safe manner, so as to have an explosion-engine, in which, if all the heat of the coal could be used in exploding water rather than in raising steam, a surprising economy of fuel should result.

But as no progress was made in such an engine, I can only refer to some old accounts of an explosion in a copper foundry, where the great establishment was literally blown up, it was said, by a workman simply spitting into a vessel of melted copper. The mere amount of steam raised from the saliva would evidently have been of no practicable avail for either good or evil, even if employed in the best modern expansive engine on the thermo-dynamic principles; but, as an explosive, its energy would seem to have been so vast that I must hope for further development of the subject at the hands of the able men of science in the Manchester Literary and Philosophical Society.

"On the Destruction of Sound by Fog and the Inertness of a Heterogeneous Fluid," by Professor OSBORNE REYNOLDS, M.A.

1. That sound does not readily penetrate a fog is a matter of common observation. The bells and horns of ships are not heard so far during a fog as when the air is clear. In a London fog the noise of the wheels is much diminished, so that they seem to be at a distance when they are really close by. On one occasion during the launch of the *Great Eastern* the fog was reported so dense that the workmen could neither see nor hear.

2. It has also been observed that mist in air or steam renders them very dull as regards motion. This is observed particularly in the pipes and passages in a steam-engine. Mr. D. K. Clark found in his experiments that it required from three to five times as much back-pressure to expel misty steam from a cylinder as when the steam was dry.

3. My object in this paper is to give and to investigate what appears to me to be an explanation of these

phenomena, from which it appears that they are intimately connected—that, in fact, they are both due to the same cause. This explanation will be the clearer for a few preliminary remarks.

4. The nature of a fog, and the manner in which the small spherical drops are suspended against their weight, is well understood. So long as the fog is at rest, or moving uniformly, the drops, being heavier than the air, tend to sink like a stone in water, and consequently they are not at rest in the air, but are moving through it with greater or less velocities, according as they are large like rain, or small like haze. This motion is caused entirely by the difference in the specific gravity of the air and water; if the drops were merely little hard portions of air, they would have no tendency to descend.

In some fogs the drops are so fine that they appear to be absolutely at rest, and will remain for a long time without any appreciable motion. The force which retards the downward motion of the drops is the friction of the air, and this is proportional to the surface of the drop and the square of the velocity. As the drops get smaller, their weight diminishes faster than their surface, and consequently the friction will balance the weight with a less velocity. The exact law is that the velocity caused by the weight of a drop is proportional to the square root of its diameter.

This is the general explanation of what goes on under the action of gravity when the fog is at rest, or moving uniformly, and we may make use of it to illustrate what goes on when the fog is subjected to accelerating or retarding forces.

5. If we imagine a vessel, full of such a compound as the fog is made of, to be set in motion or stopped, the accelerating or retarding force will have to be transmitted from the sides of the vessel to the fluid within it by means of pressure. These pressures will act equally throughout the fluid, and if the fluid were homogeneous they would produce the same effect throughout it, and it would all move together, but the pressures will obviously produce less effect on the drops of water than they do on the corresponding volumes of air, and the result will be that the drops of water will move with a different velocity to the air—that the drops of water will, in fact, move through the air, just as they do under the action of gravity. In fact, if the air is subject to an acceleration of 32 feet per second, the effect on the drops (their motion through the air) will be the same as that due to their weight. It is easy to conceive the action between the air and the drops of water. If a mass of air and water is retarded it is obvious that the water, by virtue of its greater density, will move on through the air. This property has, in fact, been made use of to dry the steam used in steam-engines. The steam is made to take a sharp turn, when the water, moving straight on through it, is deposited on the side of the vessel.

6. Owing to this motion of the water through the air, it would clearly take longer with the same force to impress the same momentum on foggy air than on the same when dry. This is obvious, for at the end of a certain time the particles of water would not be moving as fast as the air, and consequently the air and water would have less momentum than the same weight of dry air all moving together; that is to say, if we had two light vessels containing the same weight of fluid, the one full of dry air and the other full of fog, and both subjected to the same force for the same time, and at the end of this time, although they would have exactly the same motion, their contents would not, for the drops of water in the fog would not be moving so fast as the vessel. Now the energy expended on each of these vessels would be the same, but, inasmuch as the effects are different, the energy acquired by the foggy air would be less than that acquired by the dry air, the difference having gone to move the water through the air; that is to say, it would require more pressure to impress, in the same time, the same velocity on foggy air than on dry air of the same density.

7. This, then, fully explains the dulness with which foggy air acquires motion. In the passages of a steam-engine the steam is subjected to continual accelerations and retardations, each of which requires more force in the manner described with misty than with dry steam, and at each of which the particles of water moving through the steam destroy energy in creating eddies.

8. Although not so obvious, the same is true in the case of sound. The effect of waves of sound traversing a portion of air is first to accelerate and then to retard it. And if there are any drops of water in the air these will not take up the motion of the air so readily as the air itself. They will allow the air to move backwards and forwards past them, and so cause friction and diminish the effect of the wave as it proceeds, just as a loose cargo will diminish the rolling of a ship.

9. It is important to notice that this action of the particles of water is not analogous to their action in reflecting the waves of light.

It has been assumed, as an explanation of the action of fog on sound, that the particles of water break up the wave of sound by small reflections in the same way as they scatter the waves of light. The analogy, however, is not admissible; for in the case of light the wave-length is shorter than the thickness of the drops, and the surface of the drop act in the same way as if the drop were of large extent; but in the case of sound, the wave's length may be thousands of times the thickness of the drop, and instead of the whole wave being reflected it will only be a very small portion of it. Even this portion can hardly be called a reflection; it is due to the motion of the air past the drops, like the waves of sound caused by a bullet, or the waves thrown off by the bow of a ship.

10. A certain portion of the resistance which the air offers to the motion of the water through it is this—what is called in naval science *wave resistance*; but it can be shown that the proportion of this resistance to the resistance in causing eddies diminishes with the velocity, and consequently it can have very little to do with the effect of the drops of water on the waves of sound, in which the velocity of the water through the air must be very small.*

11. So far, then, I have shown the manner in which the fog diminishes the sound; it remains to consider the connection between the size of the drops and their effects. I am not aware that any observations have been made with respect to this. I do not know whether it has ever been noticed whether a fine or a coarse mist produces the most effect on sound. It does not appear, however, that rain produces the same effect as fog; and considering rain as a coarse fog, we must come to the conclusion that a certain degree of fineness is necessary.

If we examine theoretically into the relation between the size of the drops and the effect they produce, always assuming the same quantity of water in the air, we find in the first place that if the air is subjected to a uniform acceleration, which acts for a sufficient time for the drops to acquire their maximum velocity through the air, the effect of the drops in a given time—that is to say, the energy dissipated in a given time—is proportional to the square root of the diameters of the drops. This appears from the action of gravity. As previously stated, the maximum downward motion of the drops, and hence the distance they will have fallen in a given time, and the energy destroyed is proportional to the square root of their diameters. Hence, where the acceleration acts continuously for some time, as would be the case in a steam pipe, the effect will increase with the size of the drops.

This effect may be represented by a parabolic curve, in which distances measured from the vertex along the axis represent the size of the drops and the corresponding ordinates represent their effect in destroying energy.

If, on the other hand, the acceleration alternates very

rapidly, then there will not be time for the drop to acquire its maximum velocity, and if the time be very short the drop will practically stand still, in which case the effect of the drops will be proportional to the aggregate surface which they expose. And this will increase as the diameter diminishes, always supposing the same quantity of water to be present.

This latter is somewhat the condition when a fog is traversed by waves of sound, so long as the drops are above a certain size; when, however, they are very small, compared with the length of the waves, there will be time for them to acquire their maximum velocity. So that, starting from drops the size of rain, their effect will increase as their size diminishes, at first in the direct proportion, then more and more slowly until a certain minuteness is reached, after which, as the drops become still smaller, their effect will begin to diminish, at first slowly, but in an increasing ratio, tending towards that of the square root of the diameter of the drops.

This effect may be represented by a curve which coincides with the previously described parabola at the vertex, but which turns off towards the axis, which it finally approaches as a straight line.

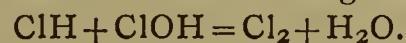
This completes the investigation, so far as I have been able to carry it. The complete mathematical solution of the equations of motion does not appear to be possible, as they are of a form that has not as yet been integrated. However, so far it appears to me to afford a complete explanation of the two phenomena, and further to show, a fact not hitherto noticed, that for any note of waves of sound there is a certain size of drop with which a fog will produce the greatest effect.

"The Chemical Constitution of Bleaching-Powder," by C. SCHORLEMMER, F.R.S.

In his classical research "On the Compounds of Chlorine with Bases,"† Gay-Lussac has shown that the bleaching compounds formed by this reaction are not direct combinations of chlorine and a base, as Berthollet believed, but that a hypochlorite and a chloride are produced simultaneously, according to the equation—

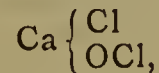


When to the compounds thus formed, a small quantity of a mineral acid is added, hypochlorous acid is set free, whilst by adding the acid in excess chlorine is obtained; because in the latter case the hydrochloric acid acts on the hypochlorous acid in the following way:—



As a ready method for preparing a dilute solution of hypochlorous acid, Gay-Lussac recommends to distil a solution of bleaching-powder with a quantity of dilute nitric acid which is just sufficient to liberate the hypochlorous acid.

According to Gay-Lussac's view, bleaching-powder is a mixture of calcium chloride and calcium hypochlorite, and the same view is held by most chemists. Professor Odling has, however, pointed out that, calcium being a dyad metal, the constitution of bleaching-powder was probably—



or it was at the same time a hypochlorite and a chloride. Of course both views explain equally well the formation of hypochlorous acid by Gay-Lussac's method. I read, therefore, with great surprise a paper by Goepner (*Dingler's Polytech. Journ.*, 209, 204), in which he states that bleaching-powder is nothing but a simple combination of lime and chlorine, which by acids is again resolved into its constituents without the least trace of hypochlorous acid being formed. He says that, although the preparation of hypochlorous acid by this method is described in all handbooks as if this experiment had been made hundreds of times, this is a mistake, and the reason why this error has maintained itself so long in chemical literature

* This reflection has nothing to do with the reverberation from clouds which occurs in a thunderstorm, which is probably due to the different density of the clouds, and takes place at their surfaces.

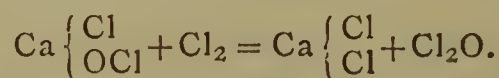
is that hitherto no reaction was known by which free chlorine and hypochlorous acid could be readily distinguished. But such a reaction has now been found by Wolters, who has shown that when chlorine-water is shaken with an excess of mercury only mercurous chloride is formed, while with aqueous hypochlorous acid it yields a brown crystalline oxychloride of mercury, which is readily soluble in hydrochloric acid, and thus offers a ready means of the qualitative as well as quantitative determination of hypochlorous acid in the presence of free chlorine.

In employing this reaction for detecting hypochlorous acid in the liquid which was obtained by distilling bleaching-powder with a small quantity of hydrochloric or sulphuric acid, Goepner could not find a trace of hypochlorous acid, but only free chlorine.

I have already mentioned that he says the preparation of hypochlorous acid by this method is described in the books as if this experiment had been repeated hundreds of times. Now this experiment has been repeated many hundred times in our laboratory only. Professor Roscoe shows it every year in his lectures, and all our students in the course of their practical work perform it, and find that the perfectly colourless distillate is a much more powerfully bleaching agent than freshly prepared chlorine-water. This is quite sufficient to show that the liquid contains hypochlorous acid. But why did Goepner fail in detecting it? Perhaps it was the fault of the analytical method? To decide these questions, I prepared hypochlorous acid by distilling solutions of bleaching-powder with dilute nitric and sulphuric acid and shook the colourless distillates with mercury. In every case the brown oxychloride was formed in quantity and possessed all the properties which Wolters has assigned to it, while by shaking chlorine-water with mercury only calomel was formed. From a careful perusal of Goepner's paper I was unable to find the cause of his failure.

Another argument against the existence of a hypochlorite in bleaching-powder is, according to Goepner, the following. The chlorine which is used in the manufacture of bleaching-powder always contains free hydrochloric acid, and thus in bleaching-powder more calcium chloride will always exist than would correspond with Gay-Lussac's formula. Now when bleaching-powder is exhausted successively with small quantities of water, the excess of calcium chloride is always found in the first solutions, whilst those following contain calcium and chlorine in the proportions corresponding to the empirical formula CaOCl_2 . This fact, however, only proves that bleaching-powder is not a mixture of calcium chloride and hypochlorite, but that the bleaching compound contained in it has the constitution which Professor Odling has assigned to it.

Professor Williamson has shown that an aqueous solution of hypochlorous acid may also be obtained by suspending finely-divided calcium carbonate in water, and passing chlorine into the liquid until the carbonate is dissolved, and then distilling the solution. In this reaction the compound $\text{Ca}(\text{OCl})\text{Cl}$ is probably also first formed and acted on by an excess of chlorine in the following way:—



MISCELLANEOUS.

Dr. Huggins, F.R.S.—The Emperor of Brazil has conferred upon Dr. Huggins, F.R.S., the distinction of Commander of the Order of the Rose.

Letts's Diaries.—The diaries for 1874 published by this eminent firm are useful for gentlemen engaged in the various professions, and also for private use. Some of the bindings are excellent.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 26.—Medical, 8.

— Geographical, 8½.

— London Institution, 4.

TUESDAY, 27.—Royal Institution, 3. Prof. Rutherford, M.D., "On Respiration."

— Civil Engineers, 8.

— Anthropological Institution 8. (Anniversary.)

WEDNESDAY, 28.—London Institution, 7.

— Society of Arts, 8.

THURSDAY, 29.—Royal Institution, 3. Prof. P. M. Duncan, F.R.S., "On Palæontology, with reference to Extinct Animals and the Physical Geography of their Time."

— Royal, 8½.

— Philosophical Club, 6.

FRIDAY, 30.—Royal Institution. Weekly Meeting, 8.

— Royal Institution, 9. Sir Julius Benedict, "Weber and his Times."

SATURDAY, 31.—Royal Institution, 3. Prof. G. Croom Robertson, "On Kant's Critical Philosophy."

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SUPPLEMENT TO THE CHEMICAL NEWS. VOL. XXIX. No. 739.

ON HEAT.*

By FREDERICK GUTHRIE, B.A., F.R.S., &c.

THE subject of the concluding lecture was "Radiant Heat and Mechanical Value of Heat."

Resuming the subject of radiant heat, it is found, that of surfaces equally smooth, some have a greater specific power of radiation than others. The ordinary means for exhibiting this and similar relations of radiating power is by a cube filled with water at the boiling-point, and turning on a vertical axis, and presenting its surface to a susceptible body, such as an air thermometer or pile. The surface of the cube is of lamp-black, of polished gold, of scratched silver and of polished silver, and each surface is brought near the hood of the pile in succession. Lamp-black is thus found to radiate more heat than the polished surfaces. Besides, when the surface of polished gold is coated over with a solution of isinglass, the heat passes through more abundantly, showing that the power of radiation does not depend wholly on the size of the surface, as determined by its roughness, but also on the nature of the surface.

The power of metallic surfaces for reflecting heat may be thus shown:—A sheet of paper is coated partially with gold-leaf on one side, and on the other with iodide of mercury, which has the peculiar property that, when heated, it turns yellow, without undergoing decomposition. Expose this paper to the heat of hot iron, and where the gold-leaf has protected the iodide, it remains red, but where not protected by the metal surface, it is converted into yellow.

The different powers which different substances have for radiating heat is shown in Nature in the formation of dew, and its kindred—we may say identical—phenomena, hoar-frost or frozen dew. Dew is caused by the loss of heat by the earth. After sunset the earth radiates heat through the air into space, and is so cooled that the water vapour in the air condenses on its surface. Accordingly, those parts of the earth's surface which radiate most heat are most thickly covered with dew. But if this radiation of heat from the earth is prevented, dew is not deposited upon it. Thus, on a cloudy night, the dew is not deposited, and one reason is because the heat radiated from the earth strikes the cloud, and is reflected back again on the earth. Another reason is, because, through moist air, the heat of the earth cannot escape as it can when the air is perfectly dry. Clouds, of course, are not watery vapour in the proper sense; they are particles of water itself, whereas water vapour is a perfectly pure transparent gas. This is seen to be the case when steam is heated. In damp muggy weather clouds from a locomotive subsist for a long time, but when the weather is dry, they quickly disappear, remaining as invisible vapour in the air.

In order to determine the quantity of aqueous vapour in the air, use is made of the hygrometer or moisture-measurer, identical in principle with the cryophoros.

It has been already noticed that radiant heat, on striking bodies, experiences either absorption, reflexion, or transmission, and the latter has now briefly to be considered. Bodies may allow light to pass through them with the greatest freedom, but may absorb heat; such bodies are called transparent, and we might call bodies which allow heat to pass through, transcalent, but the Greek diathermancy has been used instead. This word has the

same significance with regard to heat as transparency has with regard to light. Rock-salt amongst solids, halogen compounds of carbon amongst liquids, and all simple gases or gaseous mixtures amongst gases, may be taken as types of diathermanous bodies. Bodies may be opaque to light, and yet very diathermanous. The relation is remarkable between the power which different substances have for arresting radiant heat, and their power of transmitting heat by conduction. Thus CS_2 , which allows radiant heat to play through it, refuses to allow heat of conduction to pass through it. Those liquids, too, had the greatest thermal resistance which contained Ch, Br, or I, and these allow radiant heat to pass through. Water is the most athermanous, or the body which arrests the greatest proportion of radiant heat, while it conducts heat most abundantly.

It was clearly shown in the analysis of a beam of heat, that the heat is greatest a little beyond the red end of the spectrum; also that one can focus invisible heat just as one can focus cold light, these being independent of one another. With a solution of iodine in CS_2 , the light is intercepted by the iodine, whilst the CS_2 allows heat to pass. This heat reveals itself to the hand or to the air thermometer; and by a little extra care we can ignite combustible bodies in the dark by the heat of an electric lamp, or Pt may be made red hot by the voltaic current. Such phenomena are called phenomena of calorescence.

We have been accustomed to look upon heat hitherto as obtained by chemical change or in the electric lamp as the resistance which the air and carbon particles offer to the passage of electric discharge. Thus 1 pound of H, thoroughly burned to form water, will raise 34462 pounds of water, 1°C . H may be regarded as the most fierce of all bodies, and gives rise to more heat than any other substance when completely burned. Next comes carbon with its 8000 pounds of water raised 1°C . when one pound of carbon is burned. Phosphorus, again, that might be imagined to burn most fiercely, exceeds sulphur, but does not come up to carbon. This plan is used in measuring the value of coal. It is found how much water, say, an ounce of coal will heat, and the carbon in the coal is determined by the quantity of heat developed.

One of the most familiar sources of heat is that by friction, but, curiously enough, it has been the least studied till within the last twenty years. We know that, when two substances are rubbed together heat is produced—when a knife is cleaned by rubbing, when a razor is stropped on a dry horn, when a saw cuts wood, &c. To pursue this point further, take a tube in which there is a piston fitting pretty accurately; that piston has a hole in it, in which there is a little piece of German tinder, then force that piston down to the bottom of the cylinder. The tinder takes fire, heat is produced, but where does that heat come from? We cannot answer the question yet. When you expand a body by heat, you are an active agent. You put hot air into a gas, and the gas gets bigger; it can be made still bigger by releasing the pressure upon it. By the very process of exhausting or rarefying air, heat is absorbed, cold is produced. The rarefied air requires heat during its rarefaction, just as in heating air you make it more rarefied and make it larger. There can be no question of friction here because the air has been withdrawn from a hole in the bottom of the plate, but when air is allowed to enter through that orifice and heat is produced, then friction *may* come into play. The same effect may be better shown thus:—Take a mass of air which has been already compressed, and this made to impinge upon the face of the pile has a cooling effect. So ice can be formed and is formed. Imagine that you have a strong boiler and pump air into it; during the process of pumping it gets hot. Allow it to cool, and allow the air to expand, and it requires heat, which it takes from bodies in contact with it, such as water, and freezes them.

If, on the other hand, instead of this compressed air expanding, we take the mere mechanical rubbing of the air in motion against the surface, the same effect is

* Abstract of the sixth of a course of Lectures to Working Men, delivered in the South Kensington Museum on Monday, the 22nd ult.

obtained as in rubbing two bodies together. If I blow the bellows sufficiently strong upon the face of the pile, this very act of rubbing will warm the surface.

This production of heat by means of friction led people to imagine that heat was mechanical motion, and we must reconcile the known phenomena, which we have been hitherto studying with this view. Heat is generally supposed not to be a distinct thing, but an agitation of the particles of matter. According to this notion, particles of matter are moving amongst one another like gnats in a swarm, or like the heavenly bodies. Imagine that this moving mass is stopped in its motion of translation from place to place; what takes place resembles that which occurs when a moving chime of bells is stopped. They do not ring while moving as a whole, but strike a body, and the bells would begin ringing. Imagine that radiant heat in passing through space to be the motion of these particles of ether, and that these particles of ether are not without momentum; but that they are capable of both receiving and imparting similar vibrations to the particles of ponderable matter. Here, however, there is a sort of divergence in the opinions of people. Some people hold (assuming the sun as the source of heat) that the heat of the sun consists of vibrations of the particles of the sun, and that this vibration is communicated to the particles of that medium called ether pervading space between the sun and the earth. I may say that almost all people hold this view; but when the radiant heat of the sun strikes transparent bodies upon the earth, then the views of different people diverge. Some suppose that the ether pervading universal space is continued throughout the most solid ponderable matter; others hold that, as soon as these vibrations meet with ponderable matter, the ether itself ceases to exist, but its motion is carried on. There is thus a very tough fact to swallow, that ether is called an imponderable substance; and, as far as one knows, there is no such thing as weight without momentum. Now, if there be any ponderable matter between the sun and the nearest point of the earth, how comes it that force is communicated? That it is communicated is apparent to us all. Go into the shade, and take, say, a well-stoppered bottle of air (the blacker the surface of the bottle is the better), just move it afterwards a foot into the sunshine, when the stopper will be blown out, and the air expelled. This force is transmitted through interstellar space which has no weight. We are accustomed to associate momentum with weight or motion. Let us study more exactly this line of argument—the relation between the mechanical manifestation of heat and heat itself. Supposing you take a hammer, and hammer a leaden bullet with it. Here is a mass of matter going downwards, and it is suddenly stopped, but no force can be annihilated. What becomes of this great momentum? It is converted from the motion of translation into heat. It is well known that bodies can be heated in this way, but the question arises, is the heat a mere accidental attribute of this stoppage of the motion of translation, or is it necessary to it, or is it proportional, and is the one converted into the other? That question has been answered in the affirmative, and in this way. A man has got a certain amount of work to do—say a hodman having to carry 1000 bricks to the top of a house. He will only be paid when the work is done, but he may carry up these bricks one at a time, or as many as he pleases. It is clear that the financial bargain is completed, and the work is done when the bricks once at the bottom are now at the top. Supposing these 1000 bricks fall to the bottom again, they will strike the bottom with a certain force. One step further—supposing that the 1000 bricks falling down are fastened by a pulley, they will be sufficient to pull 1000 bricks up; strictly speaking, a mere fly settling on the rope will disturb the equilibrium. It matters not whether these bricks fall fast or slow, just as they could be lifted one at a time or more. So if we take a mass of matter, say 1 pound weight, or a kilogramme, and lift that up from the ground to the table, that is the unit of work. The work that is done in lifting

1 kilo. 1 metre in height is stored up in the kilo., and is then called potential; and is capable, by its descent, of lifting its own weight its own height. Take a weight held by a string, and let it fall from a height upon a plate of iron; its motion is suddenly stopped, and there is a motion of translation from place to place annihilated, but represented by the vibration of the particles gradually subsiding, which we call heat. One may compare the heat of the motion to the vibration of the leaves of trees. The tree may sway to and fro, or the leaves may rustle, and there may be the same amount of work done in the rustling of the leaves as in the swaying of the tree, *i.e.*, the conversion of motion of translation into motion of vibration. It is found that, when 430 kilogrammes fall slowly through one metre, and in doing so overcome friction, the heat produced by the friction is sufficient to raise one gramme of water 1° C. This is the mechanical equivalent of heat.

If heat be this molecular vibration, many things become clear. The *intensity* of heat of a body, or its temperature, is the rate of motion of its particles amongst one another, and this is independent of their number, that is, the size of the body and also of the weight of each individual particle. Whatever be the mass or weight of a moving particle, it can never, by one or more impacts, give a greater velocity than its own to another particle. So the temperature of one body can never be raised above the temperature of the body whence it gets its heat, and hence, also, any two bodies of unlike temperature acquire the same temperature when in contact. Again, the *quantity* of heat in a body depends (1) upon the size of the body, and (2) both upon the velocity and mass of its particles, *i.e.*, on their momentum. Heat quantity, apart from size of matter, is molecular momentum. A blow with a hammer may drive a nail further into a board than the impact of a pistol ball. So there may be as much or more heat in a heavy particle moving slowly (cold) than in a lighter particle moving more rapidly (hotter). Capacity for heat is molecular inertia. Specific heat is the ratio of molecular inertia. When a body receives heat, its particles are thrown into more violent motion. Most frequently this is followed by an increase in the orbits of the particles, which results in an increase in the general size of the body. Such is expansion by heat. Sometimes, however, as with water below 4° C., the body shrinks as it gets heat, showing that the increased rate of vibration is not accompanied by increased orbit size. Conduction of heat is the spreading of molecular motion like agitation in a crowd. When heat is produced by burning, the particles of O unite with those of C, and form compound particles; the greater the attraction between the two, the closer they get together, and the more rapid is their motion, just as those planets move fastest around the sun which are nearest to it.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, December 8, 1873.

Reply to M. Pasteur Concerning the Origin of Beer-Yeast.—M. Trecul.

Determination of the Relation of the Two Specific Heats by Compression of a Limited Gaseous Mass.—M. Amagat.—The author operated with an improved form of the method of MM. Clement and Desormes (avoiding the phenomenon of oscillation of the gaseous mass at the orifice). A slight correction was made for

lowering of temperature after compression, and the numbers got for atmospheric air were—

$$\frac{C}{c} = 1.391$$

without correction, and 1.397 with it. The mechanical equivalent of heat thence deduced was 434, which differs by only 1 unit from that recently found by M. Violle with Foucault's apparatus.

Letter from M. Poëy on the Relations between the Solar Spots, Storms at Paris and at Fécamp, and Tempests and Gales of Wind in the North Atlantic.—The storms at Paris and Fécamp coincide (in their maxima), like the hurricanes of the Antilles, with the maxima of the spots; but, in the case of North Atlantic tempests and gales, the coincidence is with the minima of spots. The writer tabulates 1067 storms at Paris in the period 1785 to 1872, and 310 at Fécamp from 1853 to 1872, also 829 Atlantic gales from 1860 to 1868. The distribution of the first-mentioned embraces 8 maximum periods of spots, of which 6 agree with the maxima of storms. Of 8 minimum periods, 5 coincide with those of the spots. The year 1810 presents a considerable maximum in place of a minimum, but it is the single strange anomaly observed in the 16 periods of storms, of which 11 correspond to periods of spots, 2 are tolerably satisfactory, while 2 are doubtful. M. Poëy compares these results with what he got for the hurricanes of the Antilles, and finds a striking agreement between the two series of phenomena—not merely in their coincidences, but in their discordances. Considering the difference of the phenomena, and that of latitude, this agreement points to cosmic influence. In the Fécamp storms, 1 maximum and 2 minima are about a year before the corresponding periods of the solar spots, and the minimum of 1867 (as in the Paris storms) is wanting. As regards the North Atlantic tempests and gales, the minimum of instances corresponds to the maximum of spots in 1860, and the maximum of instances to the minima of spots in 1867. After citing some explanatory facts mentioned by M. von Freeden, the writer arrives at the conclusion that there are in the centre of the Atlantic two systems of tempests—the one produced by predominance of the polar current, and back-flow of the equatorial current to the limit of contact between the cold waters and the hot waters of the Gulf-Stream (these are the winter and European tempests); the others inversely produced at this limit by the predominance of the equatorial current, and the back-flow of the polar current (these are the true equinoctial hurricanes which reach us from the intertropical region, starting from 10° N. lat. The relation between these two systems of cyclonic perturbations seems to consist in the fact that the predominance and energy of the polar current corresponds to the minima of the spots, while the predominance and energy of the equatorial current corresponds to the maxima of spots.

Preliminary Note on Elements Existing in the Sun.—J. N. Lockyer.

Nature of the Chemical Elements.—Observations by M. Berthelot, *apropos* of a communication from Mr. Lockyer.

Remarks by M. Dumas on the same Subject.

Observations of Falling Stars in November.—M. Wolf.—These were made at a number of different stations in France, Italy, and Portugal on Nov. 12, 13, and 14 last. Compared with preceding years, they clearly show the rapid decrease of the phenomenon, which reached its maximum of brilliancy in 1866. The retrogradation of the node of the orbit appears each year in the retardation of the phenomenon.

New Observations of the Periodic Comet of M. Faye, and Discoveries and Observations of Twenty Nebulæ, made at the Marseilles Observatory.—M. Stephan.

Movement of an Elastic Wire, One End of which is Animated with a Vibratory Movement.—M. Mercadier.—Fourth note.

Action of certain Toxical Substances on Sea Fishes.—MM. Rabuteau and Papillon.—In general, and with some interesting exceptions, organic poisons act on fishes in the same way as on species belonging to other groups of the animal kingdom. The poisons used were strychnine, morphine, thebaine, and iodide of tetramethyl-ammonium, the method being mostly that of injection.

Experiments on the Employment of Galvano-Causty in Surgical Operations.—MM. Legros and Onimus.

Observation of a Bolide at Versailles on Dec. 3, 1873.—M. Martin de Brettes.

Analysis of the Water of the Spring St. Thiébaut, Nancy.—M. P. Guyot.—This water contains per litre:—

	Grm.
Free carbonic acid	0.018
Carbonate of lime	0.310
Carbonate of iron.. ..	0.020
Carbonate of magnesia	trace
Sulphate of lime	0.350
Sulphate of magnesia	0.015
Chloride of sodium	0.059
Chloride of potassium.. ..	traces
Sesquioxide of iron	0.020
Silica and alumina	0.010
Arseniate of iron.. ..	} traces
Fluorine	
Crenic and apocrenic acids ..	

Certain Combustibles of the Basins of Donetz and Toula, Russia.—A. Scheurer-Kestner and Ch. Meunier-Dollfus.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin,
No. 17, November 24, 1873.

On Chlorobrom-Aceton.—Albert Theigarten.—This body forms well-defined crystals of pungent odour, sparingly soluble in water, but readily in alcohol and ether. It melts at 34° to 35.5°, and congeals again at 24°. Its boiling-point is 177° to 180°. Its formula is $\text{CH}_2\text{BrCOCH}_2\text{Cl}$.

Uramidic Acids.—H. Huppert.—A theoretical, or rather hypothetical, paper.

On Santonic Acid.—O. Hesse.—Heldt's saline compounds are true salts of an acid, $\text{C}_{15}\text{H}_{20}\text{O}_4$, which, in the anhydrous state, is known as santonin. Santonic acid forms white rhombic crystals, which do not turn yellow on exposure to light. It is sparingly soluble in cold, more readily in hot, water, from which it crystallises on cooling.

Reply to the Remarks of Herr Oudemans, jun., on the Molecular Power of Deflection of Tartaric Acid and its Salts.—H. Landolt.—A controversial paper, with reference to the *Berichte*, heft 14, p. 1073, and heft 15, p. 1166.

Preliminary Communication on Cholic Acid.—H. Tappeiner.—A history of the author's researches on cholic acid and its compounds.

Platinochloride of Glucinum.—A. Welkow.—This compound is formed on mixing concentrated solutions of the two chlorides, and can be obtained in yellow hygroscopic crystals, deliquescent in moist air. If heated to 100°, there is loss of water; from 100° to 150°, there is no change; but, above 150°, water again escapes, and the compound is destroyed. This substance consists of $\text{GPlCl}_6 + 8\text{H}_2\text{O}$, assuming $\text{G} = 9.4$. The crystals are easily soluble in water and alcohol, but insoluble in ether.

Derivatives of Glycerin.—Ernst Brackebusch.—On distilling iodide of allyl with nitrite of silver, the author obtained the trinitro-derivative of glyceryl, from which, again, triamido-glyceryl was produced.

Formation of Metallic Sulphides by means of Ammoniacal and Alkaline Sulphides.—E. Priwoznik.—This paper relates in great part to certain researches of

Heumann on the same subject, which appeared in the *Transactions* of the Vienna Academy of Sciences (vol. lxx., sect. ii., 1872). Solution of pentasulphide of sodium assumes a dark brown colour on contact with the oxide and the oxide of copper, and gives up a considerable quantity of sulphide of copper in contact with hydrochloric acid. Oxide and peroxide of lead, in contact with sulphide of ammonium, are converted into sulphide of lead, of a crystalline texture. Oxide of cadmium, whether blue-black or brown, yield, with polysulphides of ammonium, sulphide of cadmium; the transformation is very slow. Oxide of manganese, on heating for twelve hours in the water-bath with sulphide of ammonium, yields flesh-coloured sulphide of manganese. Hydrated peroxide of manganese, on treatment with sulphide of ammonium, disengages heat, and passes into sulphide of manganese. Oxide of iron undergoes no change.

Nature of the Elements.—J. A. Groshans.—This paper does not admit of abstraction.

Sensibility of Bromide of Silver to Light, as regards the so-called Chemically-Inactive Colours.—Herm. Vogel.—The author remarks that bromide of silver is sensitive to rays of light which have hitherto been darkness for photography. He finds that the bromide when dry is more sensitive for the less refrangible rays, but when moist far the more refrangible rays of the visible spectrum. He considers it practicable to make bromide of silver sensitive for any desired ray of light.

Phenol-Trisulphuric Acid and certain New Derivatives from Oxysulpho-Benzid.—J. Annaheim.—This paper is not suitable for abstraction.

Determination of Methylic Alcohol in Commercial Wood-Spirit.—G. Krell.—The author finds that the conversion of wood-spirit into iodide of methyl is the best means of determining its percentage of methylic alcohol. Into a glass flask, containing about 100 grms., 30 grms. of dry biniodide of phosphorus (PI_2) are put, and closed with a stopper, preferably of glass, perforated with two holes. One of the apertures contains a pipette, holding about 5 c.c., and the other supports a tube bent at an obtuse angle. The latter is fitted with a good cooling apparatus, and serves first as a cohobator, and afterwards as a condenser, the flask being gently inclined. The pipette is filled with exactly 5 c.c. of the wood-spirit in question at $15^\circ C.$, and allowed to flow down upon the iodide of phosphorus gradually—ten drops per minute. When all has been added, the flask is heated for five minutes with boiling water, during which the cooling apparatus serves as a cohobator. The apparatus is then set in a slanting position, so that the distillate may flow off, and distilled at a water-bath heat as long as anything passes over. Towards the end of the process, the flask must be entirely submerged in boiling water. The distillate is collected in a glass receiver, which is best made of a tube narrow below and accurately graduated. The receiver holds 25 c.c., and when the distillation is ended it is filled up with water to the mark 25 c.c., the condensing tube being rinsed out with a part of the water. If transparent crystals of iodide of phosphonium are formed in the condensing tube, the water for rinsing must be added very gradually. The iodide of methyl in the receiver is shaken up with the water, and its volume read off at $15^\circ C.$ 5 c.c. of chemically pure methylic alcohol yielded 7.19 of iodide of methyl.

Formula of Tauro-Carbaminic Acid.—E. Salkowski.—The author announces that the formula given for this acid in his former communication is not correct.

Liebig's Annalen der Chemie und Pharmacie.
October 24, 1873.

Decomposition of Nitric Acid by Means of Heat.—L. Carius.—A lengthy paper, not suitable for abstraction.

Chlorides of Molybdenum.—Dr. L. P. Liechti and Bernhard Kempe.—The pentachloride, $MoCl_5$, was con-

sidered by Berzelius as $MoCl_4$. It is a black body, which, after fusion, takes a radiating crystalline form. It melts at a gentle heat, and sublimes unchanged in a current of chlorine. If it has a greenish reflection, a trace of oxychloride has been formed. If heated in the air, it is decomposed, yielding a white oxychloride, MoO_2Cl_2 . If exposed to the air it deliquesces, becoming a bluish-green, and finally yielding a brown liquid. If drenched with a little water it becomes a brown solution, the change being accompanied by a hissing noise. With a little absolute alcohol it dissolves to a rich deep green liquid. The terchloride, $MoCl_3$, is formed by heating the foregoing gently in a stream of hydrogen. It is a dark brown amorphous powder, insoluble in, and not attacked by, cold water. The quadrichloride, $MoCl_4$, is formed by heating the terchloride in an atmosphere of carbonic acid. It evaporates as an intense yellow vapour, leaving the bichloride, $MoCl_2$, behind as a dull yellow powder.

Atomic Weight of Molybdenum.—Lothar Meyer.—The author's results are 95.70 to 95.66, which, of course, are to be halved, if O is assumed = 8.

Brown Oxide of Chromium.—E. Hintz.—The author finds that it is a very indifferent body. Whether it is to be considered as a simple peroxide, CrO_2 , or as a basic chromate of chromic oxide, $Cr_2O_3CrO_3$, he does not decide.

Sulpho-Ortho-Toluidinic Acid.—F. Gerver.—The author gives this acid the formula $C_7H_6NH_2SO_3H, H_2O$. He examines its potash, soda, baryta, lead, and silver salts; also the products of its decomposition by bromine tribrom-orthotoluidin, $C_7H_6Br_3N$; dibrom-sulpho-orthotoluidinic acid, $C_7H_4Br_2NH_2SO_3H, H_2O$, with its baryta, lead, and silver salts; the diazo compound, $C_7H_6N_2SO_3$; sulphotoluolic acid, $C_7H_7SO_3H$; the amid, $C_7H_7SO_2NH_2$; sulphobrom-toluolic acid, $C_7H_6BrSO_3H$, with its baryta, lead, potassium, and sodium salts; the chloride, non-crystalline; the amide, $C_7H_6BrSO_2NH_2$; sulphocresolic acid, C_7H_7O, SO_3H , with its lead and baryta salts.

Specific Heat of Zirconium, Silicium, and Boron.—W. G. Mixter and E. S. Dana.—For silicium, the authors find 0.1710; for zirconium, 0.6666; and for boron, 0.2518.

Revue Scientifique de la France et de l'Etranger,
No. 22, November 29, 1873.

The Vinegar Polype.—A very singular present has been made to the aquarium of the Society of Acclimatisation at Paris. It is a polype of the *Medusa* tribe, which the next morning after it had been placed in one of the tanks was found to have skilfully got rid of the neighbours which had surrounded it. On analysis, the water of the tank was found converted into vinegar. Hence the newcomer was evidently one of that rare species the vinegar polype, which, when placed in pure water, produces first alcohol, and afterwards vinegar.

Revue Hebdomadaire de Chimie Scientifique et Industrielle,
par Ch. Mène, No. 42, 1873.

Chemical Procedures for the Destruction of the Phylloxera and other Parasites Infesting the Vine.—Chatelain's "apathophyte" is a secret remedy, apparently formed by boiling vulcanised caoutchouc with an alkali. Perron's specific is merely sulphate of copper dissolved and mixed with sawdust, ashes, &c. Fichet's remedy is an alkaline solution of coal-tar.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 252, December, 1873.

This number contains no chemical matter.

NOTES AND QUERIES.

Grinding Machine.—Can any one inform me where, and at what cost, I can obtain any hand machine for grinding up minerals?—MARSHALL HALL.

THE CHEMICAL NEWS.

VOL. XXIX. No. 740.

ON THE BROM-IODIDES.*

By Dr. MAXWELL SIMPSON, F.R.S.,
Professor of Chemistry, Queen's College, Cork.

SOME years ago I ascertained that chloride of iodine combines directly with the olefines and the non-saturated haloid ethers in the same manner as free chlorine or bromine. I have since ascertained that bromide of iodine also enters into direct combination with these bodies.

In the following experiments I have invariably used a solution of bromide of iodine in water, which was prepared by adding rather more than a molecule of iodine in fine powder to a molecule of bromine previously mixed with about six times its weight of water. The bromine was repeatedly agitated during the addition of the iodine, and kept cold by being surrounded by water. An almost black liquid was thus obtained, which was separated from the excess of iodine.

Brom-Iodide of Ethylen.—This body was formed by passing a stream of olefiant gas into the foregoing solution, which was kept cold during the absorption of the gas. An oily liquid soon made its appearance, which was the body in question; it was then subjected to distillation, having been previously washed with dilute potash, and afterwards with distilled water. Almost the entire quantity passed over without decomposition between 162° and 167° C. This gave on analysis the following numbers:—

		C_2H_4BrI Theory.	Experiment.
C	.. ..	10.21	10.35
H	.. ..	1.70	1.79

At the temperature of the air this is a solid body, consisting of a mass of long white needles, which melt at 28° C. At 29° it has a specific gravity = 2.516. It has a sweet biting taste; on exposure to light it becomes slightly coloured, from the separation of free iodine. When subjected to the action of alcoholic potash, it yields iodide of potassium and a gas burning with a green flame, which is doubtless bromide of vinyl. It is an isomer of the brom-iodide obtained by Pfaundler,† and afterwards by Reboul,‡ by exposing bromide of vinyl to the action of hydriodic acid. Pfaundler's compound boils between 144° and 147° C.

Brom-Iodide of Propylen.—This body was formed by passing propylen-gas derived from iodide of allyl into the brom-iodine solution. It was washed with dilute potash, then with water, and distilled. The greater part passed over between 160° and 168° C., suffering, however, at the same time, slight decomposition. The distillate was then analysed, having been previously agitated with mercury to remove free iodine. The following are the results:—

		C_3H_6BrI Theory.	Experiment.
C	.. ..	14.46	14.89
H	.. ..	2.41	2.77

Notwithstanding the difference between the theoretical and experimental numbers, I believe this is a definite compound, and not a mixture of bromide and iodide of propylen. The discrepancy probably arises from the slight decomposition which the body suffered during distillation.

Brom-iodide of propylen is, when freshly prepared, a colourless oily liquid; it has a sweet and biting taste. Treated with alcoholic potash, it yields iodide of potassium and brom-propylen (C_3H_5Br).

Iodo-Dibrom-Vinyl.—When the brom-iodine solution and bromide of vinyl are brought into contact, direct combination takes place, and this body is formed. In order to complete their union, it is advisable to heat them gently in a sealed tube. A portion of the oily product thus obtained was washed with potash and distilled; almost the entire quantity passed over between 170° and 180° C. As, however, it suffered considerable decomposition during distillation, I analysed, in preference, a portion of the remainder, which had *not* been distilled, having previously dried it at 100°, and agitated it with metallic mercury to remove a trace of free iodine. The following are the results of the analysis:—

		$C_2H_3Br_2I$ Theory.	Experiment.
C	.. ..	7.64	7.67
H	.. ..	0.96	1.11

This is a colourless oily liquid; like the others it has a sweet and biting taste. Its specific gravity at 29° C. is 2.86. Heated to the temperature of 100° in a sealed tube with moist oxide of silver, it occasioned a violent explosion. Heated in an open retort with the same body, it evolved carbonic acid gas and bromide of vinyl.

CONTRIBUTIONS TO THE HISTORY OF THE ORCINS.

No. IV. ON THE IODO-DERIVATIVES OF THE ORCINS.*

By JOHN STENHOUSE, LL.D., F.R.S., &c.

A PRELIMINARY notice on these compounds has already appeared in the CHEMICAL NEWS, vol. xxvi., 279, and the present paper contains a more detailed account of my experiments.

In 1864† I published an account of a crystalline teriodorcin obtained by precipitating an aqueous solution of orcin with a solution of iodine monochloride, but I found I was unable to prepare any other iodine derivative of orcin by this process. It seems probable, however, that the method devised some years ago by Prof. Hlasiwetz,‡ and communicated by him at the meeting of the Naturforscher und Aerzte in Innsbruck, would yield the lower substitution compounds. This was found to be the case; for on agitating an ethereal solution containing equal molecular weights of orcin and iodine with dry precipitated mercuric oxide, the colour rapidly disappears, and moniodorcin is formed; this may be obtained by distilling off the ether and crystallising the residue from benzol, in order to separate an uncrystallisable oily compound which accompanies it. It is, however, still contaminated with a small quantity of mercuric iodide, which obstinately adheres to the substance, and can only be removed by re-crystallisation from a dilute aqueous solution of potassium iodide; this difficulty arises from the circumstance that mercuric iodide is more or less soluble in most of the liquids usually employed as solvents. For this reason I found it advisable to substitute plumbic oxide for the corresponding mercury compound originally proposed by Hlasiwetz.

Moniodorcin, $C_7H_7IO_2$.—1 part of pure dry orcin is dissolved in 6 parts of ether, then 2 parts of iodine are added, and the mixture agitated until the whole of the iodine is dissolved; 9 parts of very finely powdered lead oxide (litharge) are now introduced in small portions at a time with frequent agitation. A marked action takes place, accompanied by development of heat, and the colour of the solution rapidly disappears. On distilling off the ether, and extracting the residue with hot benzol, the iodorcin separates in the crystalline state on cooling. Two or three alternate crystallisations from benzol and

* A Paper read before the Royal Society.

† *Jahresberichte*, 1865, p. 483.

‡ *Ibid.*, 1870, p. 439.

* A Paper read before the Royal Society.

† *Journ. Chem. Soc.*, vol. xvii., p. 327.

‡ *Deut. Chem. Ges. Ber.*, ii., 551.

from water suffice to render the compound pure; but care must be taken not to boil the aqueous solution for any length of time, as the iodocin is thereby partially decomposed.

Monoiodocin in a pure state crystallises in colourless prisms, which melt at 86.5° , and decompose with evolution of violet vapours of iodine when strongly heated. Concentrated sulphuric acid has but little action on the substance in the cold: but when gently heated with it the iodocin is decomposed and iodine is freely liberated. Warm nitric acid likewise acts energetically, evolving nitrous fumes and liberating iodine. Iodocin is only slightly soluble in cold water, but readily in hot water. It is very soluble in ether and in hot alcohol; moderately so in benzol and in hot petroleum, crystallising out from the latter almost entirely on cooling; slightly soluble in carbonic disulphide. It is quite destitute of the peculiar astringent sweet taste so characteristic of pure orcin.

Dried *in vacuo*, and submitted to analysis, it gave the following results:—

- I. 0.332 grm. substance gave 0.311 grm. argentic iodide.
II. 0.256 grm. substance gave 0.314 grm. carbonic anhydride and 0.067 grm. water.

	Theory.	I.	II.
C ₇ = 84	33.60	—	33.44
H ₇ = 7	2.80	—	2.90
I = 127	50.80	50.63	—
O ₂ = 32	12.80	—	—
250	100.00		

These numbers correspond with those required by the formula $C_7H_7IO_2$.

Monoiodoresorcin, $C_6H_5IO_2$.—This compound is prepared in a manner similar to the corresponding orcin compound; 10 parts of resorcin and 24 of iodine are dissolved in 60 of ether, and about 110 of lead oxide are gradually added. After removal of the ether and extraction with benzol, the iodocin is purified by crystallisation from hot water, in which it is much more soluble than the iodocin. Iodoresorcin crystallises in rhomboidal prisms, which are very difficult to obtain colourless; they melt at 67° , and, like those of the orcin derivatives, decompose when strongly heated. It is much more soluble in water than iodocin, and is very soluble in alcohol or ether; hot benzol dissolves it readily, but it is only slightly soluble in carbonic disulphide. When heated with nitric or sulphuric acid it behaves like iodocin.

The analytical results were obtained from the compound dried *in vacuo* at the ordinary temperature.

- I. 0.343 grm. substance gave 0.341 grm. argentic iodide.
II. 0.357 grm. substance gave 0.354 grm. argentic iodide.
III. 0.265 grm. substance gave 0.298 grm. carbonic anhydride, and 0.053 grm. water.

	Theory.	I.	II.	III.
C ₆ = 72	30.51	—	—	30.67
H ₅ = 5	2.12	—	—	2.22
I = 127	53.81	53.73	53.58	—
O ₂ = 32	13.56	—	—	—
236	100.00			

The numbers agree with the formula $C_6H_5IO_2$.

In preparing teriodocin by the action of iodine protochloride on orcin, it was observed that a comparatively large amount of the dilute solution of iodine chloride could be added to the aqueous solution of orcin before a permanent precipitate of teriodocin was produced. It seemed possible that an intermediate iodine derivative was first formed, far more soluble than the teriodocin, and which subsequently became converted into the latter by the further action of the chloride of iodine. In order to ascertain whether this was actually the case, a dilute solution of iodine protochloride was added to an aqueous solution of orcin, containing 1 part of orcin in 50 of water, as long as the precipitate re-dissolved in the liquid on agitation. The addition of iodine was then stopped, and

the filtered solution agitated with ether. The ethereal solution, on evaporation, left an oily uncrystallisable liquid which was readily soluble in water, and which evolved iodine when heated with concentrated sulphuric acid: this liquid, on standing some days, deposited a few crystals of unaltered orcin.

I cannot conclude this paper without acknowledging the very efficient aid I have received from my assistant, Mr. Charles Edward Groves, in conducting this investigation.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 30).

The Glass.

THE flasks and vessels used were of the hardest Bohemian glass, and as thin as they could be employed. When practicable, vessels of old green German glass were used; neither this nor Bohemian glass is practically affected by reagents.

Liquids were generally kept sealed up in glass bulbs and globes, but sometimes in stoppered green German glass flasks or in "bromine" bottles. When liquids were kept in these bottles for a few days only, they were not found to have contracted any saline impurity from the glass, but after remaining for some weeks they were found to leave a visible residue on evaporation.

No cork or luting was employed in the distillations, &c.; in most cases the apparatus was blown in one piece, and the operations performed in a vacuum. The pieces of apparatus which were weighed were entirely composed of glass suspended with platinum loops. The fingers were not allowed to touch them after the first weighing.

The weight of tubes, bulbs, and flasks, even of hard Bohemian glass, constantly diminishes when the glass is long heated in a spirit- or gas-flame; this loss may amount to several thousandths of a grain in the space of two hours when a bulb of Bohemian glass 3 inches in diameter is exposed to a decided red heat in a gas-flame. Following the suggestion of Professor Stas, I have obviated this source of error by employing a bath of pure magnesia; and find that the weight remains constant even at a nearly white heat. Baths of lime have sometimes been employed with similar satisfactory results.

The special apparatus that I have used will be described in the processes in which they were required; I need scarcely say that in no case were materials of untried purity employed.

Improved Sprengel Vacuum-Pump.

[Before detailing the processes of the determination, it will be requisite to describe the means of producing a vacuum in the flasks and bulbs employed. In proceeding with the determinations, several additions and improvements have been made to the Sprengel pump as generally found in the laboratory. Working so much with this pump, I have endeavoured to avoid the inconveniences attending the usual mode of raising the mercury from the lower to the upper reservoir.

The mercury is contained in a closed glass reservoir A (Fig. 2), perforated with a fine hole at the top. This reservoir is attached to a block, capable of free movement in a vertical line, and running in grooves, and connected with the lower reservoir by a flexible tube, g.

When the whole of the mercury has run from the reservoir, A, the reservoir and slide can be lowered by liberating the teeth of the cog-wheel, k, from the detent, m; at the same time a friction-brake is pressed against the cylinder. The aim of this arrangement is to permit the slide-block to fall steadily, swiftly, and without any injurious shock upon the block, L. II is a glass reservoir, which receives

* A Paper read before the Royal Society June 20, 1872.

the mercury after flowing through the pump. When the reservoir, A, is emptied and has been lowered to the block, L, the mercury from H is admitted into A by opening the tap, i. *f* is another tap, to regulate the flow of mercury through the pump, whilst a third tap is at R. *g* is a

barometer, P, the two thus forming a differential system, by which the rarity of the atmosphere in the apparatus to be exhausted can be easily estimated. *dd* is a scale attached to the gauge.

The reservoir, A, being filled with mercury, the tap, i, is turned off, and the reservoir is raised to the top of the slide, where it is supported by the piece, r.

On opening the tap, *f*, the mercury rises in the tube, *f h*, and falling through the chamber, N, carries with it the air contained in the tube, R, and in the apparatus or bulbs attached to the tube, *b*, as in the ordinary Sprengel pump. At N the tubing is enlarged, in order that the mercury may not be forced up the tube, R, as otherwise frequently happens if the apparatus or mercury gets soiled. This liability of the mercury to run up is further obviated by raising the tube, R, above the level of the upper reservoir, A.

J, J are iron brackets supporting the apparatus. *s* is a large inverted glass receiver to collect the small portions of mercury which are unavoidably and constantly being spilled; it contains a little weak solution of carbonate of sodium. The part of the tubing, *g f h N*, forms a barometric syphon arrangement, which effectually prevents air getting into the enlargement, N, from the reservoir, A, when the mercury has completely run out; in this case no harm whatever is done to the operation, the vacuum is not injured, and the exhaustion proceeds immediately on re-transferring the mercury from the reservoir H, to the reservoir A, and raising A again into its place. The apparatus, as thus arranged, is readily manageable, with certainty of obtaining a barometric vacuum.

The mercury fall-tube of a pump in constant use frequently wants cleaning. I find the most effectual means of doing this is to put oil of vitriol into the funnel stopper, *l*, and then, by slightly loosening the glass stopper, allow a little of the strong acid to be carried down the tube with the mercury. With care this can be effected without interfering with the progress of exhaustion. The residual acid in the chamber, N, does good rather than harm. When sufficient sulphuric acid has run into the fall-tube, the funnel stopper can be perfectly closed by filling it with mercury.

The preceding description is that of the apparatus with the most recent improvements. During the determination of the atomic weight of thallium a pump was employed similar in detail, with the exception that, instead of the movable reservoir and flexible rubber tubing, a glass funnel with tubing of glass was used. The mercury passing from the funnel was broken up in its fall, and freed from adhering air-bubbles by the insertion of two silk-covered thin

iron wires extending from the funnel to the base of the tube. As equally perfect results can be obtained by both methods, the details should be considered as improvements for the sake of convenience rather than for accuracy. —November 29, 1872.]

Detection of Acetic Acid in Wines.—M. Kissel.—In separating acetic acid from wines by distillation, the acid may escape undetected, because it forms acetic ether with the alcohol. This inconvenience may be avoided by saturating the wine with baryta. The alcohol is then distilled off, and phosphoric acid added to the residue. On distilling again, the acetic acid is found in the distillate, and may be determined.

FIG. 2a.

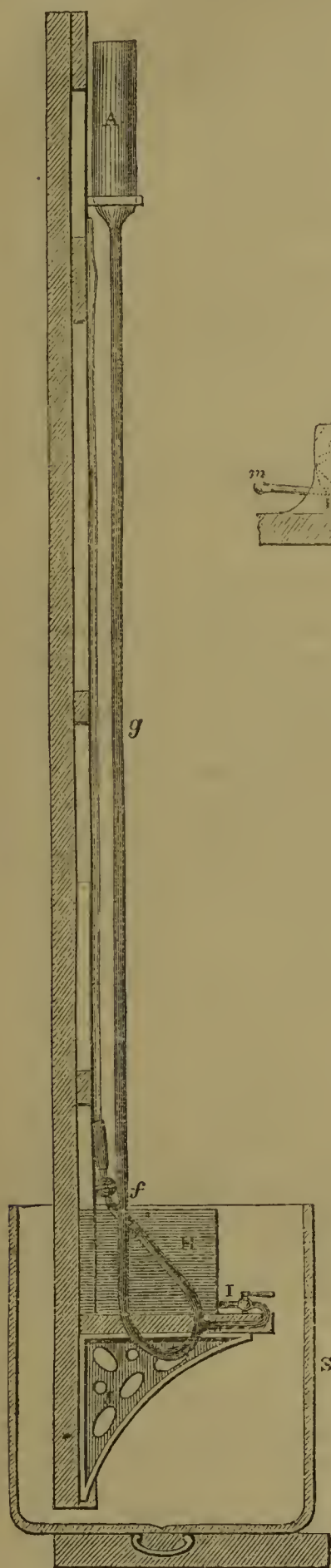
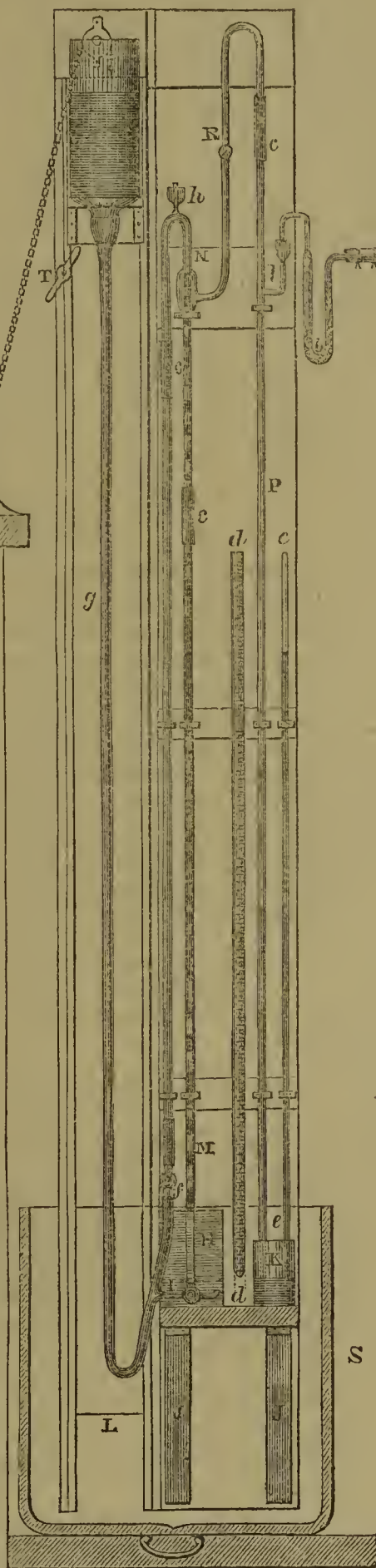


FIG. 2.



flexible india-rubber tube, strengthened to withstand the pressure by being constructed of concentric layers of rubber and canvas. *b* is a tube filled with small glass beads, and containing concentrated sulphuric acid to absorb moisture; * it is attached to *l* by means of a mercury joint. *c, c, c* are mercury joints, it being inconvenient to have the apparatus in one piece of glass tubing. *ee* is a barometer dipping into the same vessel as the gauge-

* Since writing the above description I have soldered a small glass tube to the lower part of *b*, turned up and terminating in a funnel-shaped mercury stopper. This enables me to draw off the old acid when weakened by absorption of moisture and to replace it by fresh acid, and also to pass different gases into any apparatus I may have under experiment.—W. C., July, 1873.

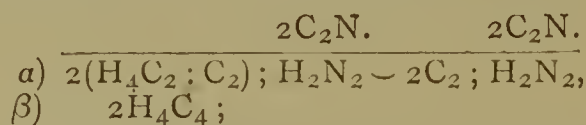
THE CHEMICAL CONSTITUTION OF CITRIC
ACID AND ITS NUMEROUS DERIVATIVES,
CRITICALLY EXAMINED AND INTERPRETED FROM THE
STANDPOINT OF THE "TYPO-NUCLEUS" THEORY.

By OTTO RICHTER, Ph.D.

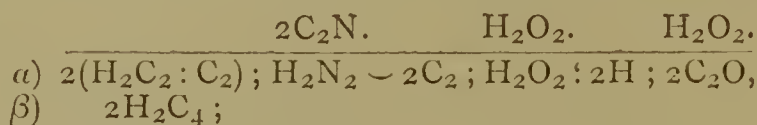
(Continued from page 43).

THE following cases have been chosen for analysis with the view of comparing the chemical formulæ thus arrived at with those embodied in the foregoing schemes.

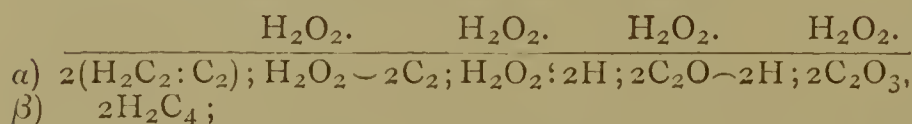
The first case refers to the artificial production of the ordinary pyrotartrate, which, according to Simpson, is obtained by decomposing the dicyanide of propylen with hydrate of potash. A simple enumeration of the chief transition products will, I trust, enable the reader to comprehend the *rationale* of a process so closely analogous to the decomposition of the dicyanide of ethylen under similar circumstances. Commencing with the dicyanide—



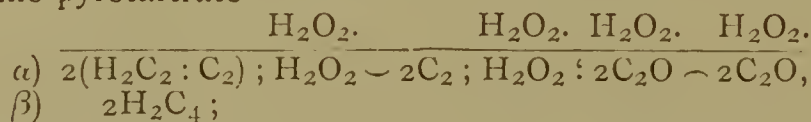
the first transition product will be the monobasic water-salt—



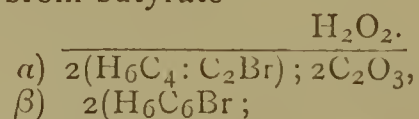
and the second will be the bibasic meta water-salt—



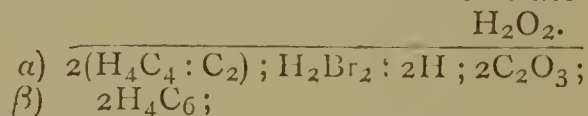
which is thus shown to be identical with the *a* meta-erythrite of the first scheme. By the loss of 2 mols. of water, this compound is then finally made to pass into the ortho-pyrotartrate—



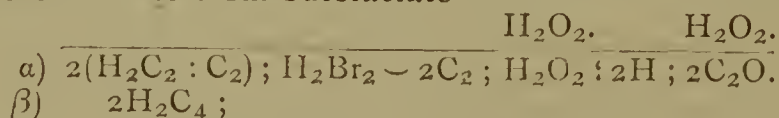
which answers to the *b* ortho-erythrite of the first scheme (compare also its production from the pyruvate, Part II. of the first paper). The second case refers to the artificial production of the ortho- and iso-pyrotartrates, which, according to Wislicenus, are formed side by side on heating the mixture containing the two varieties of cyanbutyrate with hydrate of potash. In order to account for the appearance of two varieties of pyrotartrate, where only one of them is anticipated by theory, I proceed upon the hypothesis that, under the influence of the cyanide of potassium, the brom-butyrate—



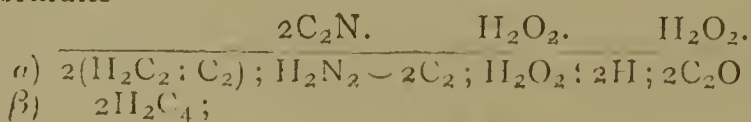
which forms the basis of this experiment, becomes transformed first of all into the isobrom-butolactate—



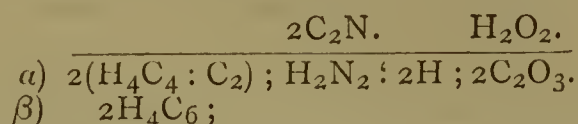
but the greater portion of this compound is soon made to experience a second metamorphosis, in virtue of which it passes into the brom-butolactate—



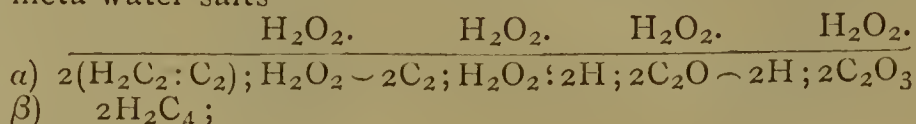
Hence the two varieties of cyan- and isocyan-butyrate, which are due to the action of cyanide of potassium on these two varieties of brom-butyrate, will be expressed by the formulæ—



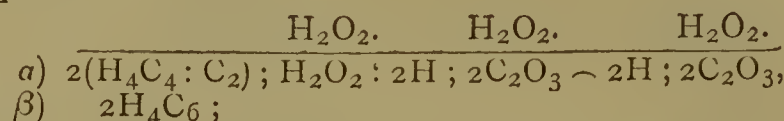
and—



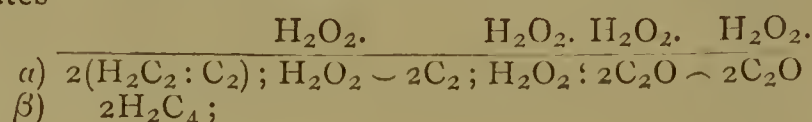
It is scarcely necessary to add, that the products resulting from the action of the hydrate of potash on these two isomerides must be, in the first instance, the two bibasic meta water-salts—



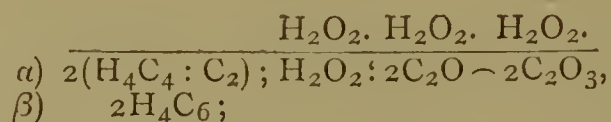
and—



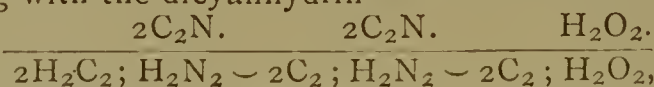
and, in the second instance, the ortho- and iso-pyrotartrates—



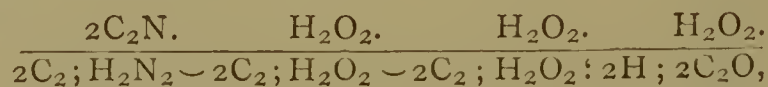
and—



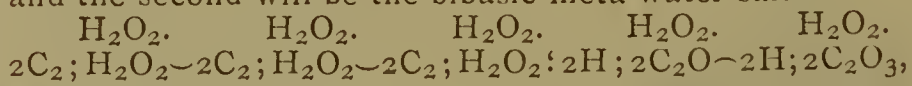
which are thus shown to be genetically related to each other in the same manner as the ortho- and iso-succinates. The third case refers to the artificial production of the oxy-pyrotartrate, which, according to Simpson, is obtained by boiling dicyanhydrin with potash-lye; and the fourth case refers to the artificial production of the carballylate, which, according to the same observer, may be got by subjecting tricyanide of allyl to similar treatment. Considering the striking resemblance of these two cases to each other, and to several cases that have already been discussed in full, I shall again content myself with a simple mention of their chief transition products. Commencing with the dicyanhydrin—



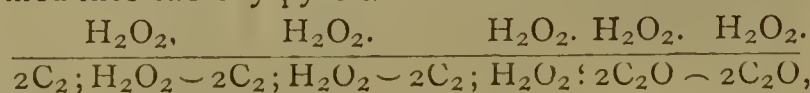
the first transition product will be the monobasic water-salt—



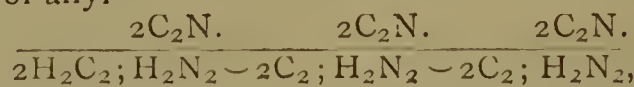
and the second will be the bibasic meta water-salt—



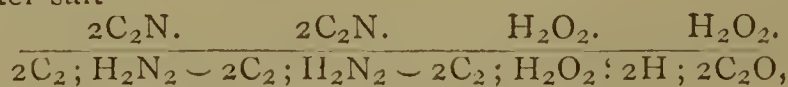
which is thus shown to be identical with the *a* meta-citraconite of the second scheme. By the loss of 2 mols. of water, &c., this compound becomes then finally transformed into the oxy-pyrotartrate—



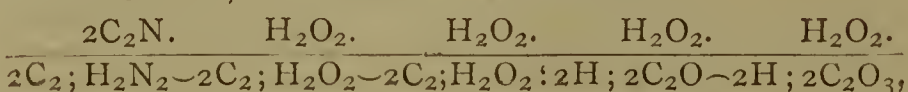
which tallies completely with the *b* ortho-citraconite of the second scheme. Commencing again with the tricyanide of allyl—



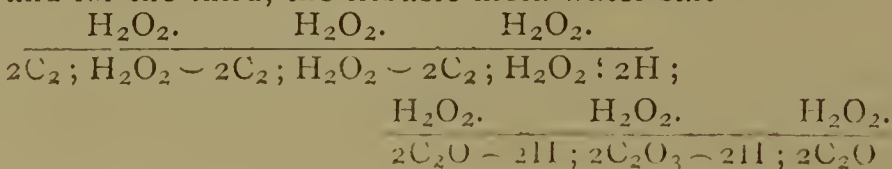
we have, for the first transition product, the monobasic water-salt—



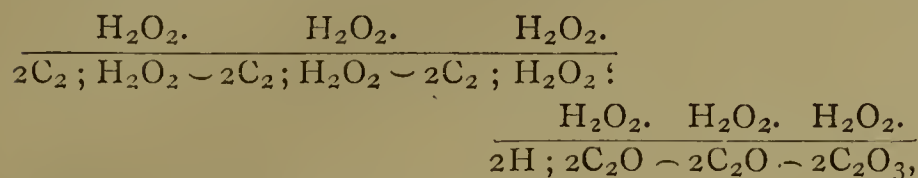
for the second, the bibasic meta water-salt—



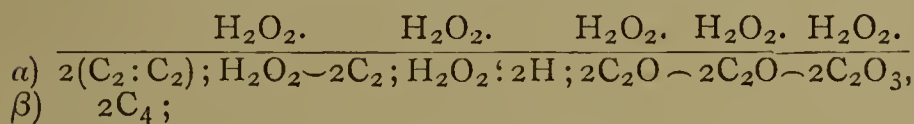
and for the third, the tribasic meta water-salt—



which is thus shown to be identical with the meta-citréite of the third scheme. By the loss of one pair of water molecules, this compound is then changed, first of all into the tribasic ortho water-salt—



which is the same as the *a* ortho-citréite of the third scheme, and thence, by the loss of a second pair of water molecules, into the carballylate—



which answers to the *b* ortho-citréite of the third scheme, and may be regarded as the next lower heterologue of the ordinary, or ortho-citrate of water (the *b* ortho-citrate of the third scheme).

I shall now, in the second part, proceed to discuss a series of questions fully as interesting and portentous as those for which I have just endeavoured to find the proper treatment and solution.

(To be continued.)

THE ESTIMATION OF SILICON, GRAPHITE, MANGANESE, ALUMINIUM, AND CALCIUM IN PIG-IRONS, &c.

By CHARLES H. PIESSE,
Public Analyst for the Strand District.

IN *Engineering*, Nos. 108, 109, also CHEM. NEWS, xvii., 100, there appeared a process by Professor Eggertz, translated from the Swedish, by Mr. P. C. Sandberg, for the estimation of silicon and graphite in pig-irons, from which, with modifications, the following is largely drawn:—

A. Silicon and Graphite.

Place into a beaker of about 200 c.c. capacity 25 c.c. of cold dilute sulphuric acid (a mixture of 1 part of pure concentrated H_2SO_4 with 5 of distilled water), and shake into it an accurately weighed quantity of about 2 grms. of the powdered pig-iron. Quickly cover the beaker with a watch-glass, and boil the liquid for half an hour; then partially remove the watch-glass, so that the liquid may evaporate till it reaches about two-thirds of its original bulk. Allow the beaker and contents to cool to about 120°F ., and then pour in 4 c.c. of HNO_3 , sp. gr. 1.20, and again boil for a quarter of an hour. Evaporate the contents of the beaker to dryness at 212°F . This is most conveniently done by fitting the beaker into a ring of a water-bath so that it may sink about three-fourths of its height into the boiling water. The drying proceeds rapidly, and is materially hastened by occasional stirring with a glass rod, conveniently left in the beaker for that purpose. By way of finishing the evaporation, the beaker may at last be put into a water-oven for a short time. When the mass in the beaker is dry, pour upon it 35 c.c. of dilute HCl (HCl , sp. gr. 1.16, 1 part; distilled water, 6 parts); boil for a quarter of an hour. Should anything but silica and graphite remain undissolved (which will be indicated by the solution being turbid), add 2 or 3 drops of concentrated HCl . Throw the silica and graphite on to a weighed filter, and wash with cold distilled water, until a few drops of the filtrate separately collected for that purpose give no iron reaction when tested with K_4FeCy_6 . Keep the bulk of this filtrate for the estimation of manganese and aluminium.

Continue the washing of the mixed silica and graphite with boiling distilled water containing 5 per cent of HNO_3 . When no iron is discovered in this filtrate, recur to

simple boiling distilled water until all the HNO_3 is judged to be removed; then dry the silicon and graphite at 212°F ., and weigh till constant.

Transfer the dried silica and graphite to a weighed porcelain or platinum crucible, incinerate the filter-paper, and place the ash into the crucible; then ignite this until all the graphite is burnt, which is effected in two or three minutes in a muffle; cool the crucible in a desiccator, and again weigh it.

Silica, dried at 212°F ., retains 6 per cent of water; therefore to obtain the results the following calculations are involved:—

Calculate 6 per cent of the weight of the ignited silica found, and subtract that amount from the loss on ignition before calculating the loss on ignition as graphite.

Calculate the ignited silica found into silicon. Perhaps the example from practice given below may make this explanation clear.

Iron employed	1.9998
Watch-glasses + filter-paper + residue ..	19.7838
„ „ only ..	19.5800
Residue (mixed SiO_2 + Gr)	0.2038
Crucible + residue + ash of filter-paper	18.28500
„ + ignited SiO_2 + „ „	18.20900
„ + ash of filter-paper (0.0018) ..	18.08120
Ignited SiO_2 found	0.12780
Total loss on ignition	0.07600
6 per cent of weight of ignited SiO_2 for } water retained at 212°F	0.00767
Gr by loss on ignition	0.06833

Multiply weight of ignited SiO_2 found by 46.66, and divide product by the weight of iron employed; result shows percentage of silicon in the pig-iron. Multiply Gr by loss on ignition, by 100, and divide product by weight of iron employed; result shows percentage of Gr in the pig-iron.

In the case of steels, &c., the weight of the sample used should be about 3.5 grms., and the quantities of acids employed throughout increased in relative proportion.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

TYNE CHEMICAL SOCIETY.

Inaugural Address, Session 1873-4.

By W. W. PROCTOR, President.

I HAVE thought that it might not be without interest to bring before you this evening a few notes on some analytical subjects. Although to some of you they may not appear altogether novel, they will have this point of interest in their favour, that they embody the results of practical experience, extending in some cases over a considerable period, and may thus claim some credit for utility which I do not seek for their novelty.

The enormous increase in the price of coal has excited universal attention, but as to the causes of this increase I do not mean to touch at present. There is one cause, however, which is universally admitted to have had a large share, and that is the enormous development of the iron trade of this country. Not only has this enormous development tended largely to give increased value to our coal, but it has also shown us that large and practically inexhaustible as our stocks of iron ore really are, they are not sufficient, but require supplementing from other countries. And this is due to a very simple reason, and one well known I dare say to you all, namely, mainly to the presence of phosphorus in the ores, which renders the iron unfit for use for many purposes.

As no simple method has, up to the present date, been

discovered for removing this evil, the efforts of the iron-master are chiefly directed to prevent the introduction of this element into his furnaces. Thus the task of detecting and estimating phosphorus in ores, otherwise suitable for the manufacture of iron, is a task of daily occurrence with the chemist; and perhaps there are few estimations which have excited more attention, or engaged the labours of a larger number of chemists than that of phosphorus. I do not propose to speak to-night of the estimation of phosphorus when it exists in large quantities in combination with lime, alumina, &c., when it plays a most important part as an element of extremely useful application in agriculture, but to confine myself to its estimation when existing in small quantities as "matter in the wrong place," to apply to it the definition of "dirt" as given by a late distinguished statesman.

One of the best methods of separating and estimating phosphorus when it exists along with iron, alumina, lime, magnesia, &c., and that I think which has been most generally adopted by chemists in the analysis of iron ores, is that in which the phosphorus is first separated from the other elements as a basic phosphate of iron, and afterwards converted into a basic phosphate of ammonia and magnesia, and ultimately weighed as pyrophosphate of magnesia. As this method is of general application, and its minute details may not be known to all of you, I shall describe it at some length, more especially as it is my object to compare it with a simpler and as I think better mode now coming into general use among chemists, namely, that in which the phosphoric acid is precipitated as phospho-molybdate of ammonia, and either weighed as such or dissolved in ammonia and precipitated as basic phosphate of ammonia and magnesia, and then weighed as pyrophosphate of magnesia.

A suitable quantity of the ore to be examined, say 3 to 5 grms., is weighed and digested with aqua regia at a gentle heat in a small beaker covered with a watch-glass; when the action has finished the cover is rinsed with a little water, and the whole evaporated to dryness, and exposed to a gentle heat until the excess of acid is expelled, and the whole of the silicic acid converted into the insoluble state; hydrochloric acid is then added, and after a short digestion boiling water is added, and the solution filtered from the insoluble matters, which are well washed. To the solution, which is heated to the boiling point, sulphite of soda is added to reduce peroxide of iron to the protoxide, a change which is readily recognised by the colour of the solution; when this has taken place the solution is boiled to expel excess of sulphurous acid, and then nearly neutralised with ammonia or carbonate of ammonia, excess of acetate of soda, potass, or ammonia added, and the liquid boiled. If the colour of the precipitate be distinctly red, it contains sufficient iron to carry down the whole of the phosphoric acid; if, however, it is whitish, a deficiency of iron is indicated, and this must be remedied either by the addition of a few drops of chlorine water, or, what is perhaps better because simpler, solution of perchloride of iron is added drop by drop until the appearance of the precipitate shows that the iron is in excess. After washing the precipitate well with boiling water it is dissolved in hydrochloric acid. Before proceeding further, I may observe that, although the filtrate from the phosphate of iron is quite clear as it first runs from the filter, it almost immediately becomes turbid, and deposits a red precipitate. As this result is owing to absorption of oxygen from the air, and consequent conversion of ferrous into ferric salts, it need not trouble the operator. To the acid solution, containing the basic phosphate of iron, citric acid is added until a precipitate is no longer produced by ammonium hydrate, which is then added in large excess. An ammoniacal solution of magnesium sulphate, containing sufficient ammonium chloride to retain the magnesia in solution, is then added, and the whole well stirred for about ten minutes, and then put aside for twenty-four hours. The precipitate of basic phosphate of magnesia and ammonia

is then filtered, but as it always contains a little iron, it is only very slightly washed, and then re-dissolved by a little hydrochloric acid being put into the beaker in which it was precipitated; this is then warmed and poured over the filter, which is washed free from acid. To the solution a few drops of citric acid, a drop or two of the magnesium mixture, and a large excess of ammonium hydrate are added, the whole well stirred, and put aside for eighteen hours. The precipitate is then collected on a filter, washed with ammoniacal water, dried, and ignited, gently at first, and afterwards very strongly, and the precipitate weighed as pyrophosphate.

When the quantity of phosphoric acid amounts to 0.1 per cent and upwards, this method, apart from the time and labour bestowed upon it, is unexceptionable. The phosphoric acid is obtained in a form which is readily collected and weighed, and of which the composition is well and definitely known. It does not demand any unusual skill or manipulation, or the exercise of any special care, other than that necessary in any chemical operation. On the other hand, the length of time which it requires, and the constant attention demanded of the operator by the number of filtrations, solutions, &c., militate seriously against its use, especially when many determinations have to be made at once.

Although this method has been modified to some extent by Mr. Spiller, it is still open to most of these objections, and thus it is well to adopt an entirely different mode of procedure, namely, a modification of Sonnenschein's method by means of molybdic acid. I may premise, however, that I was quite unsuccessful in obtaining correct results by following the method described by Fresenius. But without endeavouring to criticise it, I shall describe the process which has succeeded in my hands in giving correct and rapid results, and for the main details of which I believe we are indebted to Professor Eggertz, to whom chemists, especially metallurgical chemists, are under obligations for several quick and accurate methods of analysis.

The ore or metal, after treatment with aqua regia and evaporation to dryness, as described in the first method, is treated with hydrochloric acid. This is heated for some little time, any large excess of acid being driven off, taking care, however, that there is no deposition of basic oxide of iron during the evaporation. A little boiling water is then added, and the whole passed through a small filter. By the exercise of care it is possible to obtain the filtrate and washings in less than 50 c.c., and it is important that the bulk should not exceed 100 c.c. The solution is now heated to boiling, and it is convenient to use a flask for this purpose, as it admits of shaking the liquid with facility. It is then taken from the lamp, and an excess of solution of molybdate of ammonia added. This is made by dissolving 200 grms. of molybdate ammonia in 200 c.c. of ammonia (sp. gr. 0.880), filtering if necessary after making up the quantity of water to 1 litre. Nitric acid is now added to the solution containing the phosphoric acid until the ferric oxide, &c., is dissolved, and a yellow crystalline precipitate is thrown down containing the whole of the phosphorus. Much care is requisite in the addition of the nitric acid, as a deficiency or a large excess are both injurious. It is well to add the acid drop by drop and when the yellow precipitate appears to add a few drops in excess. After standing a short while the precipitate may be filtered off, but I prefer allowing it to stand overnight, and to filter next morning through a weighed filter, washing it slightly and very carefully with water acidulated with one-fiftieth of its bulk of nitric acid. The filtrate ought to be tested to see that excess of molybdate of ammonia is really present. Should this not be the case, it is well to add more and use this merely as a guide; making a second determination, and adding excess of molybdate ammonia at first, so as to obtain the whole of the phosphoric acid in the first precipitation. It may now be dried in the water-bath, but it is well not to allow the temperature to rise above 180° F., on account

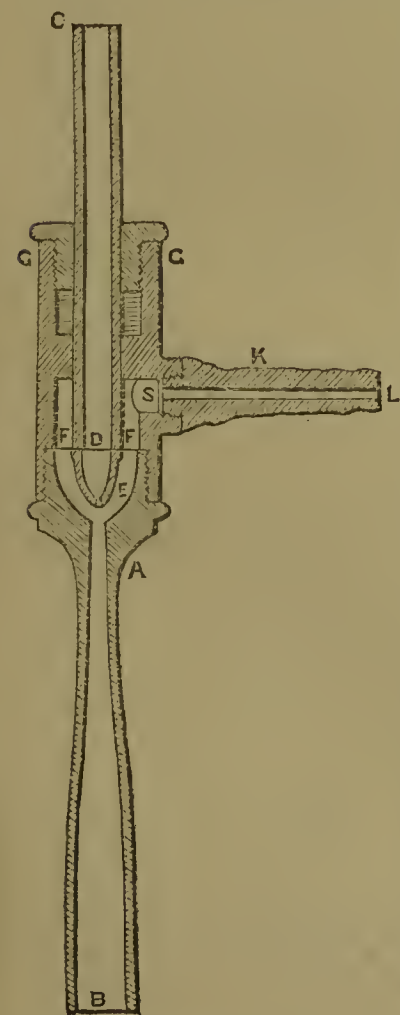
of the action of the acid on the paper. It is then weighed, and the phosphorus calculated. 100 parts of the yellow phospho-molybdate of ammonia contain 1.63 parts of phosphorus.

This is a very simple and reliable method of estimating phosphorus when carefully and properly conducted. In fact, as the precipitate contains so small an amount of phosphorus, it is, so far as I am aware, the *only* method of accurately estimating those small quantities of phosphorus which the chemist would otherwise be compelled to put down as "traces." As this method requires some amount of practice and attention to little points of detail, the chemist who uses it for the first time will do well either to work with known quantities of phosphorus or to check his results by the adoption of some other method; and it is for this reason that I have described with such fulness the two processes. In connection with this subject, I may just refer to a valuable paper by Mr. T. R. Ogilvie, read before the Glasgow Chemical Society, in which the separation of large quantities of phosphorus from these bases is treated of, and this process made available for the estimation of phosphoric acid in coprolites, wavellites, apatites, and other mineral phosphates.

I have spoken so much about filtering, that it may perhaps be appropriate here to make a few remarks upon recent improvements effected in this simple but very important part of a chemist's duties. The introduction of the Bunsen pump into laboratories has greatly tended to shorten and lighten the chemist's labours in this direction. Not only are precipitates much sooner filtered and washed, but are in many cases immediately ready for the crucible without further drying.

M. H. Lasne has lately described an aspirator which, acting on a different principle from that of the Bunsen, produces all the effects of the latter, and may be used with advantage in laboratories which are so situated as to render the application of the Bunsen pump somewhat difficult. As the use of the Lasne aspirator depends upon the fall of water through a tube of unequal bore, the fall of water required is not so great as that of the Bunsen, a point of some importance to laboratories situated on the ground floor.

Its action may be readily understood by reference to the figure, which I have taken from M. H. Lasne's paper in the *Bulletin de la Société de Chimie de Paris*. Its most important part is the diverging tube, A B; the water is brought by another tube, C D, which delivers in front of the first by a little narrower orifice, E. These two tubes are fitted into a common chamber, F, which, by means of the lateral orifice K L, can be put into communication with the apparatus in which we wish to make a vacuum. The upper tube slides in a sort of stuffing box, G, which allows the distance between the two orifices to be varied at will. As this apparatus is intended for use in laboratories where several stopcocks being fixed on the same main pipe, the pressure of the water varies according as we open or close them, this apparatus has presented the inconvenience that the vacuum being partially obtained, the water, owing to too great a diminution of the pressure, might, in place of continuing its course, be aspirated into the bell jar. It was



easy to remedy this by placing a valve, s, which opens

from outside to inside, and which permits the air to pass without allowing it to return again. Besides obviating the inconvenience mentioned above, this valve has the further advantage of retaining the vacuum like a good stopcock. The apparatus is represented one-half its real size.

While, however, the use of either of these two instruments renders filtration a very simple, and in most cases short, operation, it is not every laboratory which possesses one, and the chemist thus situated must continue to use the old methods. Now it is somewhat singular that, despite the improvements in almost everything else, the chemist still uses the same form of filter which has been in use almost from time immemorial. And yet it is not difficult to point out several defects in it. I shall not speak of the plaited or folded filter, which was used to some extent in my student days, and which seems now to be almost entirely given up, at least for analytical purposes, from causes not difficult to point out. The numerous plaits, while facilitating filtration, weaken the filter, and render it very difficult to wash a precipitate clean, thus greatly restricting its use. Returning, however, to the plain filter now in general use. It consists, as you all know, of a circular piece of paper folded twice in the direction of the circumference; on being opened one-half of the filter has a surface of a single fold of paper, while the other half presents a surface of three thicknesses. I need scarcely point out to you that not only is the filtration considerably retarded by this, but the drying also requires a longer time. To avoid these inconveniences, Mr. R. Rother has proposed a new form of filter, which, as it has been in use in my laboratory for the last eight or nine months with considerable advantage, I now desire to bring before you. A circular piece of paper is taken as before; this is cut through the line of the diameter; each piece is then folded across the line of the radius, and the double edge of the cut side turned down and folded over two or three times, and then the seam pressed down with a paper-knife or any other hard surface; and two filters are thus obtained. As there is only a single thickness of paper all round, except at the seam, solutions are filtered more rapidly, precipitates dried more easily, and any errors arising from imperfections in the paper reduced to one-half, inasmuch as for the same filtering surface only one-half the quantity of paper is required as for the old filters. I have found the amount of line in filtering-paper as usually sold make a serious difference in long analyses, and it is no mean advantage to have errors of this kind, and also those of the amount of ash in the paper, at once reduced to one-half, while the process of filtration is considerably quickened. I have now used these filters many hundreds of times,—in fact to the exclusion of all others, except when the Bunsen pump was used,—and have not had a single failure which could be legitimately traced to the fault of the construction of the filter. As in the use of the Bunsen pump, it is necessary to have funnels of an angle of 90°, which are difficult to obtain correct, and when ordinary funnels are used and the paper folded to suit this angle, the papers frequently burst, I find it often just as convenient to filter through this new filter instead of running a risk of failure with the Bunsen pump. I generally keep the paper cut in rectangular-shaped pieces, and, after folding, cut with scissors to the shape of a quadrant.

Perhaps the most unpleasant operation which the analytical chemist has to perform is the preparation and use of hydrosulphuric acid by the method in common use, namely, by means of ferrous sulphide and hydrochloric acid. I shall not speak of the inconveniences arising from stoppages of the sink by particles of ferrous sulphide and constant evolution of hydrosulphuric acid therefrom, of the dirty state of the tubes and apparatus just when wanted, nor of the blackening of the lead paint, &c., because most of these inconveniences arise from simple carelessness, and may, to a certain extent, be remedied by good management. The process, however, is a faulty

one, even with Kip's three-bulbed apparatus, of which so much use is made by Rosé, and which is a great improvement on the usual two-bottles arrangement, as it gives off the gas regularly and under control, and there is not much escape of gas or waste of ferrous sulphide when the apparatus is not in use. Even this, however, does not avoid all the defects. I have obtained a fair degree of success by the use of sulphur and paraffin, as recommended first, I believe, by Mr. J. Galletly. The apparatus I use is simply a Florence flask, connected by a wide piece of india-rubber tube with a short piece of curved Bohemian glass tubing, connected by a cork with another piece of tubing, of nearly the same bore, loosely filled with cotton-wool; to the other end of this tube is attached a short piece of tubing with india-rubber connection, by means of which the delivery tube dipping into the solution is connected. About equal parts of sulphur and paraffin are put into the flask, the india-rubber tubing slipped over the neck, and the flask heated over an argand burner. Hydrosulphuric acid soon comes off, and the evolution may be easily regulated by the heat. As the gas, unlike that given off by the ferrous sulphide, does not contain free hydrogen, solutions are more easily saturated by this gas, and the solution made by passing through water seems also to be more easily saturated, and to keep better and longer than that prepared by the usual method. In practice, I find almost all operations may be pretty conveniently made by the use of this solution, and that it is only rarely that it is necessary to make the gas. The solution has a slightly milky appearance, owing probably to finely-suspended sulphur; but I have not found this to interfere with its use in qualitative or quantitative analyses.

I have tried the method given by Mr. Skey, who writes from the Antipodes, and recommends the use of a mixture of granulated zinc and galena acted on by hydrochloric acid, but, beyond verifying the fact that hydrosulphuric acid is readily given off by this method, I have not pursued the subject further, and only mention it for the sake of the suggestion that he throws out, of making a galvanic connection by means of wires, and so obtaining at will a constant supply of the gas. We have among our members a gentleman who has had much experience both with chemical and electrical apparatus, and if he could be induced to give his attention to this, and perfect a form of apparatus for this purpose, he would confer a favour upon many chemists, and might usefully and profitably occupy an evening meeting in exhibiting and describing the apparatus.

Probably, however, all these processes will in course of time be superseded by the method described by Mr. J. P. Cooke in a recent number of the CHEMICAL NEWS. In this method, by a not very complicated arrangement of Winchester quart bottles, connected by india-rubber tubing and glass tubes with a water-head of about 30 feet, a solution of hydrosulphuric acid is obtained under pressure containing a large amount of hydrosulphuric acid in solution. By drawing this off by means of a soda-water syphon, the solution may be used with as much convenience as any other reagent. It might probably, in practice, be found worth while for the dealer in chemical reagents to supply this reagent, which he might easily do in the ordinary gazogenes, to the great advantage and convenience of the chemist. I may say that I have not myself tried this method, but have no doubt as to its success.

Perhaps I may not inappropriately bring these desultory, and I am afraid somewhat tedious, notes to a conclusion, by directing your attention to a modification of the usual alkalimetric test, kindly pointed out to me by one of our members at the close of last session, and which I have since had the opportunity of trying a few times with good results.

M. Henry, a chemist engaged in a beet-root sugar manufactory, having, owing to the exigences of the manufactory, constantly to test alkalies at night, and having

found, as most of us have done, considerable difficulty in judging the changes of colour by artificial light, bethought himself of trying the effects of monochromatic light, and this succeeded so well that he now prefers testing alkalies by this method to that by daylight. When I heard of this method, I took a wire which had been used for blowpipe work, and which contained some salt of soda in the loop, placed this in the flame of a large Bunsen burner, and found that I had got quite sufficient illumination for the purpose. I have since tried, without, however, any better result, a wire bent into a ring, and wrapped round with tow; on dipping this into solution of salt, and placing in the flame, a yellow sodium flame is obtained as long as the tow is moist, and only requires to be moistened with a little water from the wash-bottle to keep up the flame any length of time. Doubtless many other methods will readily suggest themselves for attaining the same end. On examining the liquid containing the litmus, which is blue by daylight, it appears by the sodium flame as a black liquid resembling ink, and, on adding the acid, immediately the drop is added in excess this black inky fluid becomes clear and colourless as water; this colourless liquid of course by daylight appears red. The change is very sudden, and by this slight modification an alkali may be tested quite as readily and precisely by night as by day.

In conclusion, I have to thank you for your kind attention and the courtesy with which you have listened to me; and, in declaring the Winter Session opened, have to express a hope that you will endeavour, both by your papers and discussions, to render the meetings of this session at least as interesting and instructive as those which have preceded them.

CORRESPONDENCE.

A PROBLEM.

To the Editor of the Chemical News.

SIR,—I beg to submit the following solution of the problem of "Analysis" to the criticism of your readers:—

Take first a portion of the solution in a test-tube; add a drop of HCl: the appearance of a turbidity, not removed by dilution or heating, indicates that the Hg is present as sub-salt. Therefore pass Cl through the main solution, to which the abstracted portion has been returned. Add HCl, and warm, with shaking to expel Cl; then AuCl_3 in sufficient quantity to throw down all the Sn, aiding the action with heat. Filter, add Na_2CO_3 to strong alkaline reaction, boil, then NH_4OH in excess; filter. After thus removing the Sb, precipitate the Pb with Na_2SO_4 , and some NaHO to neutralise the free acid; filter, digest the filtrate with SO_3H_2 to precipitate the Hg; filter, add some more SO_3H_2 , and some KSCN to precipitate the Cu; filter, nearly neutralise with soda, and add water largely; allow to stand some time, and then filter off the Bi; add tartaric acid (after having converted the arsenious acid in arsenic acid with Cl), then magnesia mixture; allow to stand about twelve hours, then filter off the As. Add HCl in excess, and pass H_2S to precipitate the Ca; filter. Remove excess of H_2S , HCl, and tartaric acid, by boiling and passing Cl; allow to cool, add sodium acetate in excess, then acetic acid, and pass H_2S until all Zn is precipitated. Filter, add SO_4H_2 ; boil to expel all acetic acid, then add ammonia and Am_2S ; afterwards very dilute HCl, with stirring; filter off the CO. Neutralise with soda, pass Cl, boil to expel the excess, add BaCl_2 until precipitation ceases, then BaCO_3 ; allow to digest, and filter off the Mn. Fuse the residue with Na_2CO_3 and NaNO_3 , treat with water; add AmCl , digest, and filter; Cr remains in solution. Fuse the remnant with NaHO; treat with water and a few drops of NH_3 ; filter; Al is found in the filtrate, and Fe in the residue.—I am, &c.,

WM. JOHNSON.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, December 15, 1873.

Researches on Certain New Derivatives of Butyl.—M. A. Cahours.—The author, having at his disposal a quantity of butylic alcohol of fermentation in a state of great purity, undertook to prepare certain organo-metallic radicals belonging to this series, in order to compare it with the corresponding compounds of the inferior series. The investigation offers a peculiar interest on account of the anomalies presented by this alcohol, which, though primary, is widely different from the normal butylic alcohol, the true representative of methylic, ethylic, and propylic alcohols. This product has a boiling-point lower by several degrees than that which theory would assign, and these differences are found in all its derivative ethers. M. Cahours prepared stan-butyl, mercur-butyl, zinc-butyl, aluminium-butyl, silico-butylic ether, and oxalo-butylic ether.

Laws of Magnetisation of Steel by Currents.—M. Jamin.—During passage of the current in the bobbin the bar takes a strong magnetisation, which the author calls the *total*. Let $x+z$ be the square root of the detaching force. After opening the circuit there remains a weak residue of *permanent* magnetism x . The difference between total and permanent magnetisation he calls *temporary* magnetism, or y . If i denote the intensity of the current, the total magnetisation $x+z$ increases with i to a limit corresponding to $i=\infty$. When the current is interrupted there remains only the permanent magnetism, x ; but this grows also with the intensity, i , of the anterior current. The transitory magnetisation, y , is represented by the difference between $x+z$ and y . *En résumé*, the transitory magnetism, y , is independent of the permanent state. It is only a function of i , and is added to the magnetism preserved by the bar after the current has ceased. M. Jamin next examines the case where, after permanent magnetisation is produced by a direct current, a contrary increasing current is sent through the bobbin. He seeks to explain the laws observed by the following hypothesis. The magnetism is not only expanded on the exterior surface of the bar, but each interior point, to a limited depth, is a pole. With an intensity, i , the magnetisation will penetrate to a depth e ; with a greater intensity, i' , the magnetisation will attain a greater thickness, e' . (1) This hypothesis explains the difference (too little noticed hitherto) between total magnetisation only maintained by the current, and an equal permanent magnetisation equal to the first, but stable. It may occur that the total magnetisation produced by a weak current penetrating to a depth, e , is equal, in absolute value to the permanent magnetisation remaining after action of a more powerful current penetrating to a greater depth, e' , but having at each point less intensity. (2) The ulterior action of a current of the same direction less than i , or at most equal to i , will be to produce the transitory magnetisation, z , due to this current; this will occur whatever the depth, e' , to which the first magnetisation has penetrated; that is, whatever the previous state of the bar, provided that e' is greater than e . (3) But when the current, i , ceases to flow the layer of thickness, e , will cease to be super-saturated; we then find the original permanent magnetisation.

Additional Remarks on the Nature of the Chemical Elements.—M. Berthelot.—The study of specific heats tends to establish a positive character distinguishing the simple substances of the chemistry of the present from its compound substances; and the importance of this

character increases by reason of the mechanical significance now attached to notions of specific heat.

Evaluation, in Mechanical Units, of the Quantity of Electricity Produced by a Battery Element.—M. Branly.—The object of the author's experiments was to estimate in electrostatic measure the quantity of electricity transmitted in a second by a battery element in a circuit of given resistance. An insulated metallic sphere received n times per second a constant charge A , which was removed each time by connecting with the ground by the bobbin of a galvanometer. The quantity of electricity, nA , traversing the bobbin deflected the needle; and it sufficed to compare this deflection with that caused by the flow of electricity from a Daniell element in a known circuit. It was verified that the charge of the sphere is proportional to its radius, to the potential of the pile, and to the number of discharges. The conclusion arrived at from the experiments is, that a current of intensity, $\frac{1}{330000}$, causes to circulate, in a second, a quantity of electricity represented by—

$$104699 \times \frac{371.4}{51.25} \text{ units.}$$

Water of Wells in general, and of those of the Town of Beausais in particular, from the Hygienic point of view.—M. Decaisne.—This town is shown to be greatly in want of sanitary improvements.

Falling Stars of December.—M. Tisserand.

Bulletin de la Société Chimique de Paris, tome xx., No. 11, December 5, 1873.

Action of Aërated Water on Lead.—M. Fordos.—The danger arising from the employment of leaden pipes has been much exaggerated, and is certainly far smaller than that resulting from the use of shot in cleaning out bottles. The author, having shaken up shot in bottles in the ordinary way, filled four of them respectively with white wine, red wine, quinine wine, and vinegar. After allowing the liquids to stand for a few days, he discovered lead in solution. These experiments may serve, he adds, to explain the frequent presence of lead in the human system, a phenomenon so general that Hervy, Devergie, and Orfila have considered it a normal constituent.

Action of the Waters of the Seine and Ourcq upon Lead.—M. Fordos.—The author finds that the waters of the Seine and Ourcq attack lead, though more slowly than distilled water. The action is more rapid the more finely divided the metal. New lead is less rapidly attacked than old. The product of the action of these waters consists of carbonate of lime and carbonate of lead, and these waters, after this reaction, contain no lead in solution, or merely an infinitesimal quantity.

Certain Minerals from the Bismuth Deposits of Meymac.—Ad. Carnot.—*Native Bismuth*, with a crystalline fracture, bright, with its ordinary lustre. *Sulphide of Bismuth*, of fibrous texture, black, slightly bluish, and containing traces of lead, iron, antimony, and arsenic. *Oxide of Bismuth*, or, rather, *Hydrated Carbonate*, derived from the sulphide, whose fibrous structure it preserves, but presents appearances otherwise much varied. *Antimonial Bismuth*, with a little lead, arsenic, and sulphur, &c., of a greyish colour and a metallic aspect. *Mispickel*, containing small proportions of antimony, bismuth, and lead. *Carbonate and Sulphate of Lead*, with their customary appearance. *Molybdate of Lead*, in small tubular crystals, sometimes presenting a honey colour and a fatty lustre of tolerable brightness, sometimes covered with a brown ferruginous coating. *Wolfram*, of easy and brilliant cleavage, containing, along with the usual constituents, a proportion of tantalic acid much higher than has hitherto been observed. *Tungstate of Lime*, in lamellar masses, with its peculiar fatty lustre and a greyish brown colour. *Hydrated Tungstic Acid*, sometimes of a pale yellow shade, more often of a deeper yellow, and of an aspect like that

of wax; it contains variable proportions of lime and iron, and appears to result from an alteration of tungstate of lime by vitriolic waters coming from the decomposition of pyrites.

Extraction of Vanadium, and on an Application of Vanadate of Ammonium.—M. R. Boettger.—The author has found vanadium in variable proportions in all samples of pisolithic iron, and that in a larger proportion than hitherto supposed. The ore, well powdered, is heated for a long time to redness with nitre and soda. It is extracted with boiling water, and neutralised with nitric acid free from nitrous vapours, the reaction being left feebly alkaline. The bulk of the alumina and silica is thrown down. The filtrate yields, on the addition of nitrate of baryta, a precipitate of vanadate of baryta, from which the vanadic acid is easily separated. To make the fine vanadic ink, 1 part of pyrogallic acid is ground very fine with 3 parts of gum arabic and 3 parts of vanadate of ammonia, with the addition of rain-water.

Treatment of Telluriferous Minerals.—M. V. Schröter.—The author shows that it is better, after treating the ore with aqua regia, to precipitate the gold with oxalic acid or glycerin rather than with sulphate of iron. The tellurium thrown down afterwards is more easily purified, and the gold falls free from tellurium. The selenium which is found in telluriferous minerals in larger amount than commonly supposed is precipitated along with tellurium by the action of sulphurous acid. The first portions of the precipitate contain all the selenium, with small quantities of tellurium. Their separation is easily effected by treating the precipitate with nitric acid, and distilling the liquid filtered from the tellurous acid. In the precipitation of tellurium by sulphurous acid, there comes a moment when the precipitation ceases, although the current of gas continues and the solution still contains tellurium, but the whole of the latter falls on diluting with water. In fact, a solution of tellurium saturated with hydrochloric acid is not precipitated by sulphurous acid.

Sensitive Reagent for Free Oxygen.—M. R. Boettger.—The reagent is ammoniacal solution of nitrate of silver, not containing free ammonia. On adding a few drops of this solution to water containing peroxide of hydrogen and boiling, the silver is at once reduced.

Revivification of Animal Charcoal.—MM. Pfleger and Divis.—The authors use a dilute and boiling solution of ammoniacal salt. The first effect of this is the elimination of the lime or carbonate of lime absorbed by the charcoal. The ammonia thus set at liberty acts upon the organic matters absorbed. The apparatus is so constructed that the excess of ammonia traverses a series of receivers containing the carbon to be treated, and finally enters a condenser.

Tome xx., No. 12, December 20, 1873.

Rotatory Power of Mannite.—M. L. Vignon.—The author succeeded in estimating the rotatory power of mannite by mixing its saturated solution with a similar solution of boracic acid. Such a solution examined, after filtration, with the Soleil apparatus in tubes of 200 m.m., gave a constant deviation of 5 divisions to the right. There is no combination between the mannite and the boracic acid. Borax increases the rotatory power to 21 divisions in the same direction.

Determination of Oxygen in the Gases which Escape from the Lead Chambers.—M. L. Vogt.—The author describes an apparatus by means of which a known volume of chamber-gas is collected, after having made it pass through a solution of bichromate of potassa and a caustic potassa lye contained in Liebig's bulb-tubes. He adds then to the gas a solution of ammonio-ferrous sulphate, and a sufficient quantity of ammonia to precipitate all the ferrous oxide. The oxygen of the gaseous mixture is then entirely absorbed by this ferrous oxide. The water is then allowed to re-enter the apparatus, when the quantity of

water absorbed indicates the volume of oxygen. The precipitate of oxide may be also re-dissolved in sulphuric acid, and titrated with permanganate. The apparatus consists of an aspirator-flask, filled with water recently boiled. This aspirator is connected with the gas to be taken, and the water is allowed to escape. The apparatus is then filled with the gas, which has been previously freed by the bulb-tubes from all gases except oxygen and nitrogen. There is a tube with a tap fixed to the flask for the introduction of the reagents.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxii., No. 14, December 4, 1873.

Spurious Wines.—Count Sokolnicki, a proprietor of vineyards at Medoc, informs us that a chemist, so-called, is selling to the wine-forgers of the Gironde a liquid of which a few drops suffice to colour a wine. An œnanthic liquor, simulating the bouquet of Medocs, is sold openly at Bordeaux. A solution of sugar is allowed to ferment on the pressed grapes, the colour and the flavour are added, and with these materials wines of the best growths are counterfeited.

Manufacture of Permanent Beer.—M. Pasteur.—The author recommends the use of a pure yeast—the mode of preparing which he does not describe—free from vibriones, bacteria, *Mycoderma aceti*, &c. With such yeast, the process of fermentation can be carried on in the absence of air, or in the presence only of limited quantities of pure air. Beers thus made can, he declares, be preserved for an indefinite length of time, even at temperatures of 20° to 25° C.

Revue Scientifique de la France et de l'Etranger, No. 23, December 6, 1873.

Association Française pour l'Avancement des Sciences, Lyons Meeting.—(Geological Section, Session of Aug. 27, 1873).—M. Friedel described a new mineral species, to which he gave the name *Delafossite*, a combination of sesquioxide of iron and suboxide of copper, $\text{Fe}_2\text{O}_3, \text{Cu}_2\text{O}$. It resembles graphite to such an extent that it has figured under that name in collections for fifty years. Its colour is grey, it marks paper, has a decided and easy cleavage, and is found in small veins, enveloped in lithomarge. It appears to be found at Ekatherinenburg, Ural. M. Friedel announced that he had analysed a telluride of gold and silver from Kara Hisar, Asia Minor, and which belongs to the variety of Hessite named Petzite. Fra Onesimo exhibited to the Section a specimen from the iron mines of St. Leon, Sardinia. This specimen, concreted like the psilometane of Romanèche, consists of protoxide of iron, containing neither manganese nor hæmatite.

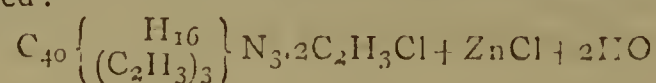
Reimann's Fürber Zeitung, No. 43, 1873.

A considerable part of this number is taken up with strictures on a contemporary and rival, the *Muster Zeitung*. Not knowing the circumstances of the case, we can only say that it is "a very pretty quarrel as it stands."

Thereon follow receipts for a black on jaconnet, a black on moire, for printing a red and white on black ground, for a red-brown on woollen yarn, and a black and a grey on cotton-wool.

New Aniline Red.—M. Ferrière.—Ammoniacal solution of oxide of copper is poured into acetate of aniline, and saturated with sulphuric acid; a rich purple-red colour is produced. The liquid, after concentration, is allowed to stand, when crystals of sulphate of ammonia are deposited, and removed by filtration.

A methyl-aniline green, manufactured by Bindschedler and Busch, of Basel, was found by Appenzeller, on analysis, to be a double salt of perchloride of tin and the hydrochlorate of the green base. The following formula is appended:—



[The reader will perceive that, while the text speaks of chloride of tin, the formula indicates chloride of zinc.]

Revue Universelle des Mines, de la Metallurgie, des Travaux Publics, des Sciences et des Arts Appliqués à l'Industrie, July and August, 1873.

This number contains no chemical matter.

NOTES AND QUERIES.

Spent Oxidee from Gas-Purifying.—"X. T." will thank Mr. George E. Davis to have the goodness to state his method of analysing this substance, or say where it may be found.

Valuation of Anthracen.—I shall feel greatly obliged if any of your readers will tell me how to proceed to estimate the percentage (approximatively) of anthracen, chrysen, and pyren in a sample of commercial crude anthracen.—T. H. D.

Notes on the Utilisation of Sewage.—(From the "Report of the Main Drainage Committee for 1864," vol. 487).

3482. Did you not state in your book that you consider that a stock of fish tends to make the river pure?—Several years ago, at the time when I was making those enquiries, I was struck by this fact, which I have noticed repeatedly since, and which in fact I have noticed this week: that some fishes (minnows first of all, and various large common river fish) accumulate round the mouths of some of the sewers, and make them their great feeding grounds. It is very well known that there are arrangements in nature of that kind for the supply of food for various animals, which then prey upon one another. At all events I have noticed repeatedly near the mouths of our large sewers shoals of small fish feeding.

3483. Do you consider that they tend to make the river pure? If they convert, in the ascending series of organic matter, those putrefying excrements into healthy life, of course they do so *pro tanto*.

3484. If the river is rendered noxious by the sewage, does it not kill the fish, and thereby destroy the natural remedy for the evil?—The fish have then no chance.

3639. (To Mr. Walker.) Did you not state that your land had been actually deteriorated in value by these applications of sewage?—Yes, I understand that a gentleman who is going to become the tenant has had it valued, and that it was estimated as being £20 an acre deteriorated in value. It certainly has destroyed the fine herbage; it has left the ground covered with tufts of coarse grass.

3749. (To Mr. Dales.) Does not the earth possess great power of abstracting fertilising matter from liquid?—It does, and is a great deodoriser as well.

3750. Has this power of the earth to abstract these fertilising matters a limit?—Most decidedly.

3751. That limit is soon reached, is it not?—Yes, you may soon deluge it with the sewage.

3752. If you saw discoloured water running through the drains after you had applied the sewage, would you consider that that limit had been reached, and that the earth was already so saturated with fertilising matter that it would not abstract any more?—Of course.

3753. If you saw the water running from the land coloured you would consider, would you not, that the sewage was wasted, unless the drains were too near the surface?—I should.

3827. (To Mr. Tom Taylor.) Did they not propose, while their case was pending, to deodorise their water sewage with lime?—Yes.

3828. It was proved that that would be utterly destructive to the fish, was it not?—Yes, that was one point.

4040. (To Mr. Rawlinson.) Besides that sewage, we have the sewage of Kingston, Teddington, Twickenham, Oxford, and other places on the Thames itself?—Yes, that constitutes the 80,000 people whom I have mentioned above the point at which the companies are compelled to draw their supply of water.

4041. There are somewhere about fifty towns, I believe, on the Thames and its tributaries before the water reaches London?—I believe there are.

4041. The Wandle receives the sewage of Croydon, Carshalton, Mitcham, and other places, does it not?—Yes.

4063. (To Mr. Rawlinson.) The river Aire, which passes through Leeds and Bradford, is stated to be as bad as the Medlock; is that the case?—It is very foul.

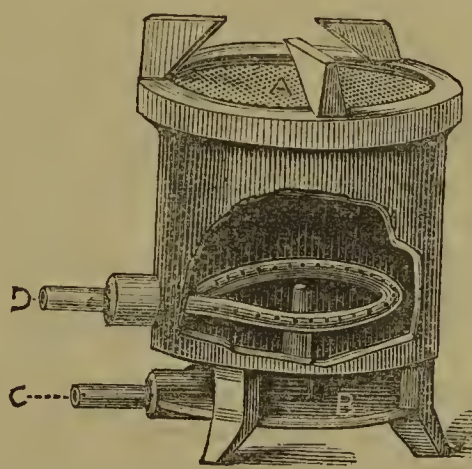
Governments and Guaranteed Securities Permanent Trust.—Second Issue, 1874.—The principles of the present issue will be similar to those of the first, although some modifications in the details of carrying them out have been thought desirable. These embrace the permanent maintenance of the fund in its entirety; provision for reserve; payment of a fixed minimum interest; the further immediate distribution of a percentage of each year's realised profit as bonuses in cash to the whole body of certificate-holders; and, as far as possible, the redemption of certificates out of profits remaining after paying the annual bonus. The trust funds will be invested in carefully selected governments and guaranteed securities. Whenever any portion of the capital originally invested is set free by the operation of sinking funds or otherwise, it will be immediately re-invested in the same or a similar security. No single investment will exceed a maximum of one-tenth of the whole fund, and, to fortify thus obtained, one-half per cent on the nominal amount of the capital subscribed will be annually set aside to reserve. The revenue of the Trust up to £6½ per cent will be distributed as follows:—One-half per cent will be devoted to working expenses, one-half per cent to the reserve fund, five per cent to interest, and one-half per cent as bonus.

MEETINGS FOR THE WEEK.

- MONDAY, Feb. 2.—Medical, 8.
— Royal Institution, 2. General Monthly Meeting.
— London Institution, 4.
- TUESDAY, 3.—Royal Institution, 3. Prof. Rutherford, M.D., "On Respiration."
— Civil Engineers, 8.
— Anthropological, 8.
— Zoological, 8½.
- WEDNESDAY, 4.—London Institution, 7.
— Society of Arts, 8.
— Geological, 8.
— Microscopical, 8. Anniversary.
- THURSDAY, 5.—Royal Institution, 3. Prof. P. M. Duncan, F.R.S., "On Palæontology, with reference to Extinct Animals and the Physical Geography of their Time."
— Royal, 8½.
— Royal Society Club, 6.
— Chemical, 8. Dr. Tommasi, "On the Action of Benzyl Chloride on Camphor." Dr. C. R. A. Wright, "On Isomeric Terpenes and their Derivatives (Part III., On the Essential Oils of Wormwood and Citronella.)" Dr. H. How, "On Two Coals from Cape Breton, their Cokes and Ashes."
- FRIDAY, 6.—Royal Institution, 8. Weekly Evening Meeting. M. Garrod, "On the Heart and the Sphygmograph."
— Geologists' Association, 7½. Anniversary.
- SATURDAY, 7.—Royal Institution, 3. Prof. G. Croom Robertson, "On Kant's Critical Philosophy."

1871.—FIRST-CLASS BRONZE MEDAL, Royal Cornwall Polytechnic Society. 1872.—SILVER MEDAL. 1873.—INTERNATIONAL EXHIBITION PRIZE MEDAL.

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above. For higher temperatures the light must be applied on the surface of the gauze A, which will give a large body of clear blue flame. A special pattern is made with a blast tube, by which the flame on the surface can be concentrated and urged until it gives almost a clear white heat, the temperature depending on the air supplied through the blast tube.

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Subscriptions will be received by the LONDON AND COUNTY BANK on behalf of the Trustees of this Fund, for the above Certificates up to the nominal amount of £1,000,000. Coupons for interest, payable half-yearly on the 1st January and 1st July, and Coupons for Bonus, will be attached to each Certificate.

Principles of the Trust.—The principles of the present Issue will be similar to those of the first, although some modifications in the details of carrying them out have been thought desirable. They embrace the permanent maintenance of the Fund in its entirety; provision for Reserve; payment of a fixed minimum interest; the further immediate distribution of a percentage of each year's realised Profit as Bonuses in Cash to the whole body of Certificate-holders; and, as far as possible, the redemption of Certificates out of Profits remaining after paying the Annual Bonus.

Investment of the Trust Funds.—The Trust Funds will be invested in carefully selected Governments and Guaranteed Securities, such as Stocks, Obligations, and Bonds of Home, Foreign, or Colonial Governments, States, and Municipalities, and Guaranteed or Subsidised Stocks, Shares, and Obligations of Railways and Public Works, or Mortgages or Debentures on similar undertakings. Whenever any portion of the Capital originally invested is set free by the operation of Sinking Funds or otherwise, it will be immediately re-invested in the same or a similar security.

Security of Average fortified by Reserve.—No single investment will exceed a maximum of one-tenth of the whole Fund, and, to fortify the Security thus obtained, one-half per cent on the nominal amount of the Capital subscribed will be annually set aside to Reserve.

Distribution of Revenue.—The Revenue of the Trust up to £6½ per cent will be distributed as follows:—One-half per cent will be devoted to working expenses, one-half per cent to the Reserve Fund, five per cent to interest, and one-half per cent as bonus.

Redemption of Bonds.—Whenever the Revenue in any one year exceeds £6½ per cent all further Profit will be devoted to the redemption of Certificates at the rate of £125 for each £100 Certificate, drawn in such year by lot in the presence of a public notary.

Position of Investor.—On the above basis it will be seen that an Investor in the present Issue would receive interest

at the rate of £5 19s. per cent, and would also share in an Annual Cash Bonus not exceeding 10s. (equal to 11s. 11d. per cent) for each subscription of £84, so that his investment may yield interest at the rate of £6 10s. 11d. per cent; further, in the event of his Certificate being drawn, it would be redeemed at the rate of £125 for an original investment of £84, and so in proportion for any smaller or larger amount.

Ultimate Ownership of the Entire Fund.—It is anticipated that at the end of twenty years a considerable proportion of Certificates will have been paid off out of *surplus profits* at the rate of £125 for each £100 Certificate, and the entire original Trust Funds and Securities, including the Reserve Fund, will then become the property of the remaining Certificate-holders, who will have to decide, at a special meeting to be held for the purpose, whether the Funds shall be realised and divided amongst them in proportion to their respective holdings, or whether the Trust shall be carried on for a further period.

Expenses.—The Trustees have signed a contract under which all preliminary expenses, inclusive of brokerage on the original purchases, stamps, advertisements, legal expenses, and all charges, are undertaken for 2 per cent on the actual amount of Subscriptions received.

Committee and Auditors.—A General Meeting will be convened as soon as possible to nominate a Committee of Certificate-holders and to appoint Auditors.

Inspection of Deed of Trust.—A Draft of the Trust Deed can be seen at the Offices of the Trust, and at the Offices of Messrs. Davies, Campbell, Reeves, and Hooper, Solicitors, 17, Warwick Street, W.; and Prospectuses with printed Forms of Application attached, obtained of the Secretary, F. B. Behr, Esq., at the Offices of the Trust, 38, Nicholas Lane, E.C.; of the Solicitors; and of the Bankers, where all Subscriptions must be paid.

Funds Receivable by Bankers.—All Dividends, Capital Funds, Premiums, and Bonuses are receivable by the London and County Bank, 21, Lombard Street, London, E.C.

Return of Deposit on Allotment.—In cases where no allotment is made, the deposits will be forthwith returned in full.

Dates of Payments.—Payments by Subscribers are to be made as follows:—

At the rate of £5 on Application, for each £100 subscribed.

„	15 on Allotment,	„
„	20 on 20th March,	„
„	15 on 1st May,	„
„	15 on 1st June,	„
„	14 on 1st July,*	„

£84 for each £100 subscribed.

* Less Interest accrued on Previous Payments at the rate of £5 19s. per annum, equal to 19s. 4d. for each £100 subscribed, leaving a Balance of £13 os. 8d. to be paid.

Discount on Prepayment.—Subscribers may prepay the Instalments under Discount at the rate of Four per cent per annum, on any day on which an Instalment falls due.

Exchange of Securities for Certificates.—Subscriptions will also be received in the form of Tenders for Securities in which the Trust Funds are to be invested as specified in the Prospectus, but the Trustees reserve the absolute right to accept or refuse such Tenders.

Issue of Certificates.—Certificates will be issued as soon as possible after the Subscriptions have been paid up in full, and the Securities purchased.

THE CHEMICAL NEWS.

VOL. XXIX. No. 741.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 55)

SECTION III.—THE CHEMICALS.

In this section I shall detail the methods adopted in the preparation of thallium and the reagents in a chemically pure state.

Water.

Ordinary distilled water is mixed with a little crystallised permanganate of silver, and boiled for about half an hour. An excess of sulphuric acid is next added, and it is again boiled for half an hour. The supernatant solution is then transferred to a German green glass retort, and distilled over a water-bath at the rate of about one drop a minute. The end of the neck of the retort is drawn out,

FIG. 3.

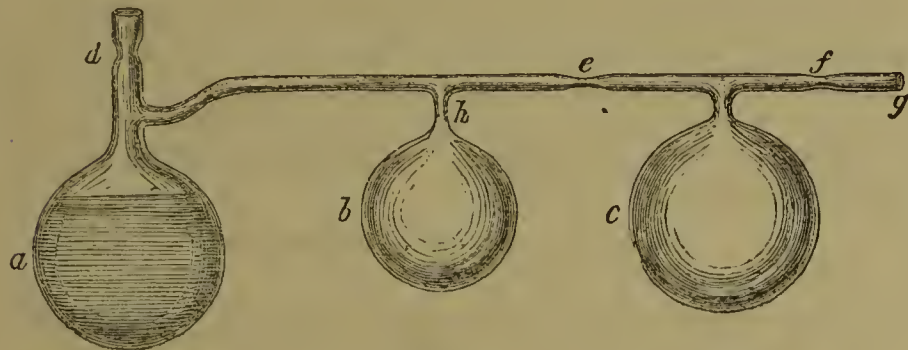
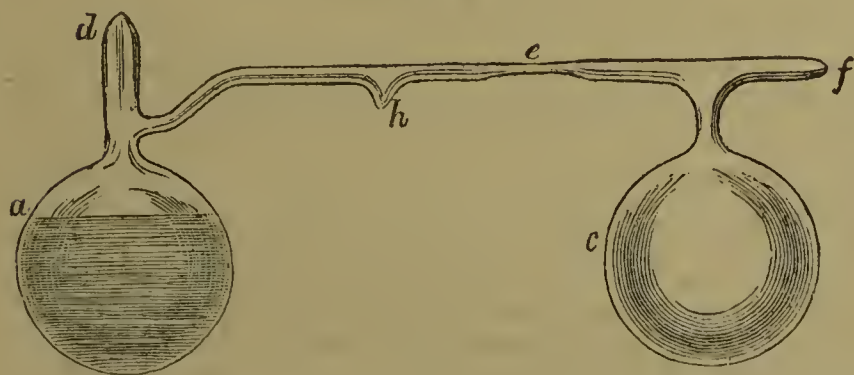


FIG. 4.



and fitted tightly into the mouth of the flask used as a receiver. The first portions of water which distil over are always to be rejected, and the distillation is stopped when about three-fourths of the contents of the retort have come over. The product of this distillation is then mixed with freshly precipitated oxide of silver, and allowed to stand, with frequent agitation, until a few drops of the decanted clear solution exhibit an alkaline reaction. The water is then introduced into an apparatus shown at Fig. 3. *a, b, c* are three globes made of hard German glass, *a* and *c* holding about half a pint each, *b* holding about four ounces; they are connected by tubes as shown, the tubes being contracted at the places *d, e, f*. The water, containing a little oxide of silver dissolved in it, is introduced through *d* into the globe, *a*, until *a* is nearly full. The contracted part at *d* is then sealed up before the blowpipe, the end, *g*, is put into connection with the Sprengel pump from which the U-tube containing sulphuric acid has previously been removed, and the mercury set running. Heat is applied to the globe, *a*, containing the water until gentle ebullition (under diminished pressure) sets in, the globes *b* and *c* being kept cold with ice. This is continued until no more air, either from the apparatus or from

the water, is carried down by the falling mercury. When this is the case, the globe *a* is allowed to cool, and the tube is sealed up at *f*, the vacuum being maintained as perfect as possible. By inclining the tube and globes, any water which may have distilled over from *a* into *b* or *c* is now poured back into *a*. The two end globes, *a* and *c*, are then placed in water-baths, whilst the centre globe, *b*, is immersed in melting ice. A gentle heat being applied to the water-bath containing *a*, distillation rapidly proceeds without actual ebullition, and water condenses in *b*, its condensation in *c* being prevented by warming the water-bath in which *c* is immersed. When about one-fourth of the contents of *a* has thus distilled over, the operation is stopped, and the bulb, *b*, removed by sealing the contracted part of the tube at *h*; any trace of ammonia which might happen to be in the water as introduced into *a* will thus have been collected in the bulb, *b*, and removed. The apparatus now has the appearance shown at Fig. 4. The globe *c* is now cooled in melting ice, and gentle heat being applied to the bath containing the globe *a*, distillation again proceeds, the condensation this time being into *c*. The first portions of water which come over into *c* are used to rinse out that globe, a dexterous movement throwing it all over the inner surface without throwing any of the liquid out of *a*. After two such rinsings, distillation is allowed to proceed without ebullition until

FIG. 5.

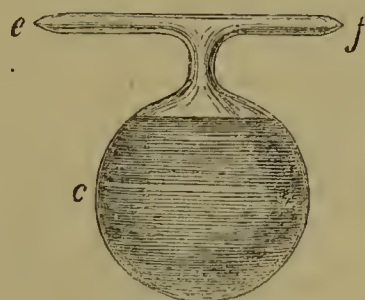
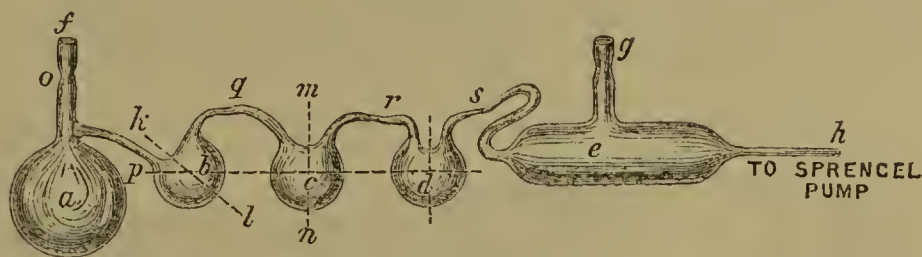


FIG. 6.



four-fifths of the water has distilled from *a* to *c*. The tube is then sealed at the contracted part, *e*, and the globe *c* (Fig. 5), containing what I believe to be absolutely pure water *in vacuo*, may be set aside for future use. It will be observed that the water, almost chemically pure to begin with, has in this manner been distilled and further purified in the entire absence of atmospheric air. When some of this water is required for use, the glass tube is touched at *f* with a blowpipe-flame. As soon as the glass softens, the atmospheric pressure forces the glass in forming a fine hole. In this way no fragments of glass get into the water, as might be the case if the end of the tube were broken off after scratching with a file in the usual manner. As much water as is needed is driven out by warming the globe, and the water remaining unused may be sealed up again.

Water purified in this manner was employed in the final crystallisations of all the salts used in the investigation, in rinsing out the apparatus, and generally in all operations where its employment was likely to increase the accuracy of the result.

Nitric Acid.

The apparatus in which the nitric acid was prepared is represented in the accompanying figure (Fig. 6). *a, b, c, d*

* A Paper read before the Royal Society June 20, 1872.

are glass globes, *a* being about 4 inches, and the others about 2 inches diameter; they are connected by fusion with glass tubes bent as represented in the drawing, and contracted at the points *o*, *p*, *q*, *r*, *s*. The cylindrical tube *c* is connected by means of a flexible joint, *iiii* (Fig. 8), to the Sprengel pump: this joint consists of several pieces of glass tube held closely together by means of india-rubber tubing; the pieces of tubing are fastened with two or three turns of silk-covered iron wire. A little glycerin smeared over a joint of this description renders it quite air-tight, whilst the apparatus is capable of considerable movement. A mixture of glacial phosphoric acid and nitrate of silver in atomic proportions, and coarsely ground together in an agate mortar, is introduced into the globe *a* until half-full, the cylinder *c* having previously been filled through the opening *g* with pieces of caustic soda. The tubes *f* and *g* are now sealed up at the contracted portions, and the Sprengel pump is connected to *h*. Exhaustion is proceeded with, the apparatus being gently warmed at the same time until moisture is no longer visible, and the mercury is as high as the vapours present will allow it to rise. The bulb *b* is then immersed in a freezing-mixture, and heat is cautiously applied to the bulb *a*. The nitrate of silver and phosphoric acid soon fuse together to a clear liquid, and vapours of nitric acid mixed with nitrous acid are copiously evolved. The mixture froths considerably, and care must be taken that none rises so high as to pass into the bulb *b*. In this and the other bulbs nearly all the vapours condense, the small quantity that escapes being caught by the caustic soda in *e*. If, through spirting or inadvertence, some of the solid matter is carried over from *a* into *b*, the contents of *b* are easily decanted back into *a* by tilting the apparatus into such a position that the line *kl* would become horizontal: owing to the curvatures of the connecting-tubes, no liquid which might be in the bulbs *c* or *d*, and none of the pieces of caustic soda in *e*, can get out of their place. When the reaction between the phosphoric acid and nitrate of silver has been pushed as far as convenient (too strong a heat must not be applied, or the nitric acid is in part decomposed as it is liberated), the tube connecting *a* and *b* is sealed in a spirit-lamp, and the globe *a* drawn off. The bulb *c* is now thoroughly washed out with nitric acid by distilling a little over from *b*, letting it condense in *c*, and then pouring it back by inclining the apparatus so that the vertical line *mn*

FIG. 7.

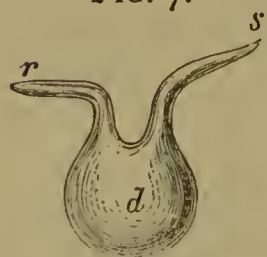


FIG. 8.



would become horizontal. The bulbs *b* and *d* are now warmed in water-baths, whilst the bulb *c* is immersed in a freezing-mixture. Distillation rapidly proceeds without ebullition, the acid almost entirely condensing into *c*. When about four-fifths of the contents of *b* are distilled into *c*, the tube is sealed up at *q* before the blowpipe, and the bulb *b* drawn off.

The next operation is to clear the acid in *c* and the rest of the apparatus from nitrous vapours. For this purpose the mercury of the Sprengel pump is set gently in motion, and the apparatus is very moderately heated from time to time until the vacuum is as perfect as the tension of nitric acid vapour will admit.* When this is effected, the bulb *c* is gently warmed in a water-bath, whilst *d* is immersed in a freezing-mixture. The temperature of *c* is so adjusted that distillation proceeds slowly without ebullition. When four-fifths of the contents of *c* have come over, the

mercury-pump working slowly all the time, the connecting-tube is sealed before the blowpipe at *r*, and *c* is drawn off. The flame being then applied at the contracted part *s*, the bulb *d*, containing the pure nitric acid, and having the appearance shown at Fig. 7, is removed. The acid may be kept unchanged for any length of time, provided it be not exposed to the light. When required for use, the end of one of the tubes is perforated with a blowpipe-flame, as described under the heading "Water." By heating the bulb, any desired quantity of acid is driven out, when the remainder can again be sealed up.

(To be continued).

ON THE ESTIMATION OF THE ACETIC ACID IN ACETATE OF LEAD.

By HENRY SEWARD, F.C.S.

A SAMPLE of the acetate of lead is dissolved in distilled water, litmus solution added, and a moderate excess of standard carbonate of soda solution measured in. The whole is then filtered, and the precipitate washed till the washings no longer affect litmus-paper, the washings being collected separately, and evaporated before adding to the filtrate. The filtrate is coloured with a few drops more litmus solution, if necessary, and exactly neutralised with standard solution of oxalic acid.

Equal quantities of the standard solutions neutralise each other; therefore if in an estimation 10 c.c. of carbonate of soda solution has been added, and 8 c.c. of oxalic acid solution is required, the difference, 2 c.c. of carbonate of soda solution, is the quantity neutralised by the acetic acid.

ON THE SPECTRA OF BORIC AND PHOSPHORIC ACID BLOWPIPE BEADS.

By CHARLES HORNER.

MR. H. C. SORBY has shown that many substances can be detected in blowpipe beads by means of their spectra, and in his excellent paper* describes several ingenious methods, including tests, whereby uranium may be recognised in quantities of $\frac{1}{100000}$ th, or $\frac{1}{300000}$ th grain. In a valuable communication† Major Ross proposes the employment of phosphoric and boric acids as better reagents than microcosmic salt or borax in some departments of mineralogical analysis; and I have been recently engaged in a series of experiments, using these acids with a certain modification, and submitting the coloured beads to the test of spectrum analysis.

I have now the honour of laying before the British Association an account of the results.

In these experiments I employed the flame of a large composite candle as a source of heat; and the apparatus used was the same in all respects as that described by me in a late paper.‡

With reference to the various fractional quantities named in this communication, I must premise that each oxide had been carefully weighed to $\frac{1}{50}$ th grain, and the smaller portions obtained by repeated divisions. But although great care was exercised in these operations, yet the numbers must only be regarded as approximate.

Referring, then, to the diagrams; No. 1 represents the spectrum of a green bead containing about $\frac{1}{1000}$ th grain of uranium oxide dissolved in phosphoric acid, and the spectrum closely corresponds with that of a concentrated acid solution of uranous phosphate, the differences being a slight expansion of the several lines, but ϵ in the solution

* If acid vapours pass into the tubes of the Sprengel pump they do no harm, being carried down at once. The small quantity which condenses in the tubes may be afterwards removed by passing some distilled water through the pump, and then drying with warm air, or by passing oil of vitriol through the pump.

* *Proc. Roy. Soc.*, vol. xviii., p. 197. "On some Remarkable Spectra of Compounds of Zirconia, and the Oxides of Uranium."

† *Ibid.*, vol. xx., p. 449. "On Pyrology."

‡ *CHEMICAL NEWS*, vol. xxvii., p. 241. "On the Spectra of some Cobalt Compounds in Blowpipe Chemistry."

giving a single band instead of being double as in the spectrum of the bead. This spectrum varies with the amount of oxide present; for with 1-200th grain the faint band in the yellow, δ , is absent; and 1-800th in an almost colourless bead will give α , γ , and the double bands, ϵ , very faintly, whilst 1-1600th grain gives α as a mere line. This well-marked spectrum will allow of uranium being easily detected in the presence of many oxides, such as iron, nickel, vanadium, and copper, which furnish beads having orange, yellow, and green tints respectively, but without giving any absorption-bands. No. 2 is the spectrum of a phosphate of chromium bead, and by means of the fairly well-marked absorption-lines in the red 1-200th grain can be determined.

I may here remark that the slit of the spectroscopic should be nearly closed, and strong lamp-light employed to see these lines, or, indeed, all the spectra lying near the red end.

The spectrum of a didymium phosphate bead is shown in No. 3, which exhibits the complement of lines due to 1-100th grain; but with 1-200th the line β is absent, and even 1-400th grain may be detected, but then the principal lines near the sodium line are only faintly recognised.

The only other compounds which I will now mention with phosphoric acid are tungsten and molybdenum oxides.

1-200th grain of tungsten oxide communicates to a phosphoric acid bead a splendid deep blue tint resembling cobalt dissolved in borax, especially when a trace of soda is added, and gives an obscure band drawn in No. 4. With molybdenum oxide the bead while hot is a pale green colour, the spectrum merely cutting off part of the red and blue, but when cooling turns a beautiful reddish-violet, and exhibits the broad absorption in the green ray shown in No. 7. I have found 1-200th grain should be dissolved to afford a good result; and the absorption occurring in the green enables us readily to discern any bands in the red or yellow rays, due to uranium, cobalt, didymium, or chromium which might happen to be present in any molybdate. In all the foregoing experiments the beads were exposed to the action of the reducing flame, and phosphoric acid continually added until they became clear.

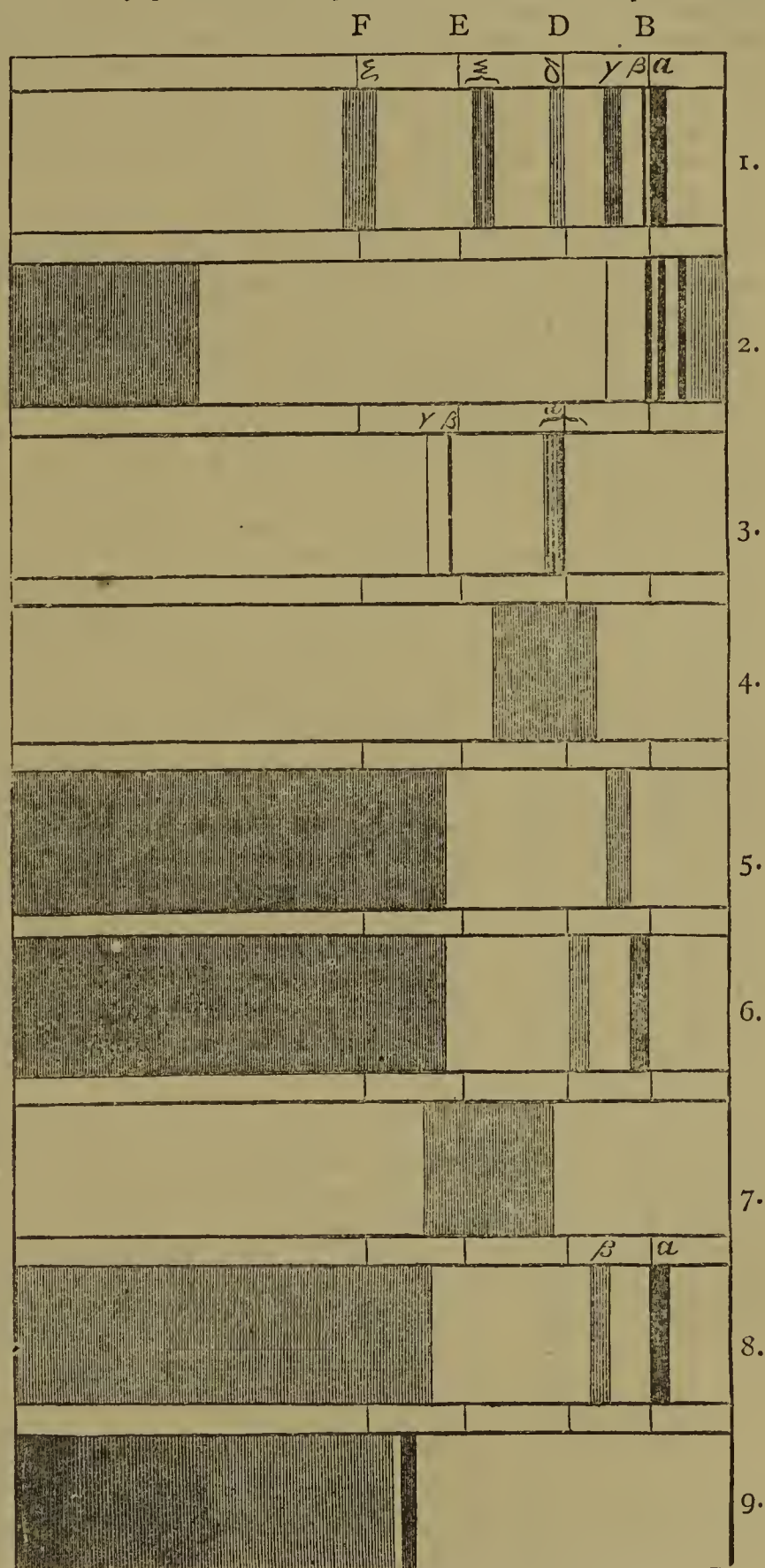
When experimenting with boric acid I adopted the plan of fusing the substance along with the acid simultaneously, and in this way obtained some interesting results. The following proved to be the best method:—A small quantity of boric acid is taken upon the moistened loop of platinum wire, slightly heated that it may adhere, then the merest trace of the substance added, and the whole submitted to the apex of the outer flame until the bead is as free as possible from air globules. No more acid should be used than will just fill the loop, that the resultant bead may be no thicker than the wire.

I have found this to be an excellent test for nickel, which yields a bead giving out reddish-purple streaks with an exceedingly minute quantity of the oxide. Most remarkable are the results which I obtained with the oxides of tungsten, molybdenum, and cadmium when treated in the way just described; for so delicate is the spectrum method, that at least 1-10,000th grain of the two former oxides may be detected by means of the eminently characteristic absorption-bands.

If a bead of the acid is formed, and fused until it ceases to impart any green colouration to the flame, a little tungsten oxide then added, and again subjected to the action of the outer flame, on observing the cold bead with a lens it will be noticed bluish streaks surround the dark specks of undissolved oxide, and these, when examined by a microspectroscope, are found merely to cut off a small portion of the red.

When, however, a trace of tungsten is treated in my manner we obtain a bead giving a burnt-umber coloured precipitate, which shows a well-marked absorption-band with a general absorption extending over the

blue to about the centre of the green, as depicted in No. 5. It appears this reaction is attributable to the sulphuric acid invariably present in ordinary pure boric acid, and that certainly one, if not two, sulphides are formed during fusion, the general absorption due to a brown sulphide, and the single band to a green or blue sulphide; for by adding sulphur to the well-fused bead named in the last paragraph, I succeeded in developing this spectrum. The bead should be wetted with distilled water, dipped into finely powdered sulphur, and held at the point of the



outer flame. Most of the sulphur burns away, but the black residue remaining is often sufficient to give the reaction; if not, a second or third application never fails to be successful. When a little sodium carbonate is carefully added to the bead a second band is developed; and if the amount of tungsten and soda be comparatively large, and then submitted to the action of the inner flame, the colour while hot is a clear orange-brown, which on cooling turns an olive-green. Often, however, the constituents may be in a proportion which gives an almost colourless bead in the inner flame, but then the above colour reactions are easily produced by gently re-heating the bead. It must be borne in mind that much soda materially affects the delicacy of the test.

The deportment of a molybdenum oxide with boric acid affords the striking spectrum, No. 8, consisting of two well-marked bands and a general absorption—indicating, in my opinion, two separate compounds. The addition of soda produces the same colour reactions as the tungsten compound, and similarly interfering with the test. In the spectrum the bands are altered, β becoming darker, and α considerably diminished in intensity, besides both bands being slightly raised towards the sodium line. An interesting phenomenon may be observed by examining the boric acid beads as they gradually cool with a small hand spectroscope. If the hot beads are held a short distance from a bright flame, and at the same time the instrument adjusted for the spectra to appear in the field of view, as the temperature falls the absorption-bands will be seen to emerge from the extreme red end of the spectrum, faintly at first, but increasing in intensity as they approach their normal position. The same phenomenon may be witnessed over and over again by carefully warming the beads.

Having discovered the tests for tungsten and molybdenum depended on the presence of sulphur, it occurred to me that if any salt of cadmium were treated in like manner I should most probably obtain a bead yielding a precipitate of the yellow sulphide. Such I found to be the case, and it is at once the most efficient blowpipe test for this substance. A moderate heat is applied until a finely-divided precipitate diffuses itself throughout the bead, which is a deep brick-red hot, by transmitted light, and when cold, a bright canary-yellow by reflected light. If the bead is exposed to a prolonged high temperature the reaction is destroyed, since the salt dissolves, but may be reproduced by the addition of sulphur.

No. 9 diagram is the spectrum of the cadmium compound showing a narrow band between b and F , with some shading in the blue.

It will therefore be seen that in phosphoric acid beads we may readily distinguish even three or four substances in one bead by means of their spectra, a fact of special importance when examining complex minerals; also by the absence of certain bands, and variable intensity of others, we may form a fair judgment as to their relative quantities, and that most delicate reactions may be produced with boric acid by proceeding according to the methods adopted in this paper.

Finally I may remark that I have applied these tests to many minerals, including some molybdates and tungstates, with such satisfactory results as to conclusively show the desirability of more frequently employing the spectroscope in this branch of chemical analysis.

My thanks are due to Mr. G. M. Whipple, B.Sc., for his kind assistance in some laboratory operations during the period of my experiments.

EXHIBITION OF APPLIANCES FOR THE PRODUCTION AND ECONOMICAL USE OF FUEL, IN CONNECTION WITH THE SOCIETY FOR THE PROMOTION OF SCIENTIFIC INDUSTRY, MANCHESTER.

THE chief object has been to concentrate the attention both of producers and consumers of fuel upon the great question of economy, and through the medium of the Society to bring together those who are concerned in the speedy solution of the problem. Some of the most important and practical appliances known to many who may visit the Exhibition will not be seen there, owing to the difficulties and disadvantages attendant upon the first efforts of a young Society scarcely known to the public.

The following was the original classification to which the council asked the attention of the exhibitors. No exhibitors have been named in classes 6 and 7; and 3 and 4 it has been found convenient to amalgamate.

- (1). Appliances which may be adapted to existing steam furnaces, &c., whereby an improved combustion of the fuel is secured, and a direct diminution in the quantity required is effected.
- (2). Appliances which may be adapted to existing steam boilers, &c., whereby the waste heat of the flue gases or of exhaust steam is utilised.
- (3). Appliances which may be adapted to existing steam boilers, pipes, and engines, whereby loss of heat from radiation and conduction is prevented.
- (4). Appliances which may be adapted to existing steam boilers and engines, enabling them with safety to realise the great economy resulting from the use of high pressure steam or superheated steam.
- (5). New or improved furnaces (using solid, liquid, or gaseous fuel), boilers, and engines of all descriptions, specially adapted for the saving of fuel.
- (6). Apparatus which, by producing a cheap and abundant gaseous fuel, will supersede the costly carriage of coal, obviate the present enormous waste attending its use in the solid form, and condense and save the valuable sulphur, ammonia, and other by-products of the distillation now injuriously affecting iron and other smelting processes, and in a vast number of operations discharged as poisons into the air.
- (7). Apparatus or engines for obtaining power advantageously from heat through any other medium than steam.
- (8). Natural and artificial fuels of all kinds.
- (9). Coal cutting machines. Peat manufacturing machines.
- (10). Domestic and other fires, stoves, ranges, and apparatus of all kinds (using coal, gas, or other fuel) for cooking, and for warming rooms and buildings.
- (11). Mechanical or other arrangements for securing the delivery of proved weights of fuel to the domestic consumer.

Entering at the south door is seen a wooden model of Davey's Patent Differential Expansive Pumping Engine, 200-horse power, for the New Hartley coal-pit; the engine is intended to lift 1500 gallons of water per minute 420 feet high. This is exhibited by Hathorn, Davis, and Co., of Leeds.

On the right-hand side of the building the first object which engages our attention is Erskine's Patent Economiser. This consists of 10 horse-shoe pipes about 4 inches in diameter, and all connected; these are placed in the flue communicating with the chimney. The waste heat from the boiler fire encircles these pipes, and causes the water which flows through them to enter the boiler at a temperature of 280° F.; and as these pipes are liable to become covered with soot and dust, instead of having a scraper, as in many instances is done, a pipe about 2 inches in diameter passes through the entire length of the horse-shoes, which is perforated with holes about 6 inches apart. The pipes are allowed to get hot, and the steam is now blown on to them, which, according to the inventor's statement, effectually cleanses them. The advantages which Mr. Erskine claims are, that from the peculiar form of his economiser, it causes no diminution or obstruction to the draught in the flue. It maintains a thorough circulation of the water through all the tubes, thus preventing the accumulation of scale; it is easy of access to every part, so that if one of the pipes is injured it can easily be replaced.

Andrew Bell shows a fine set of spiral economisers; they have the exact shape of three condensing worms put together. Each worm consists of 70 feet of pipe, and a three-coil machine is sufficient for a 40-horse boiler. Mr. Bell has shown great ingenuity in the casting of these iron worms; it would not be an easy undertaking to cast the worms in one piece, in fact practically impossible. The spirals are cast in half circles, having a spigot and facet joint. The joints fit so well into each other, that the circle can be formed and lifted without the joints parting; moulding boxes are put round these

joints, and hot metal run upon them, so that it forms a perfect spiral when they are all connected. This arrangement does away with all flange joints, so that no leaking can possibly occur, and also secures a perfectly smooth surface for the action of the scraper, which revolves, ascending and descending according to the spiral form of the coil. It is said that a saving of at least one day's consumption of fuel per week is effected. The water having a continuous circulation, all sediment is held in solution and passes through the coils, thereby avoiding deposit. Each coil is tested to a pressure of 300 lbs. per square inch before leaving the works. Economisers of various forms make a great show, and it is difficult to say which is the best.

Twibill, of Manchester, exhibit a fine perpendicular economiser, which consists of a collection of tubes set vertically in the flue. These tubes are tested to a pressure of 500 lbs. to the square inch. Some experiments were performed some time since after the heater had been in use for some time. The first test was taken at six o'clock on Monday morning; the temperature of the water in the pipes was 140° F. At four o'clock on the same day it had risen to 284° F., on Friday morning at six o'clock the temperature was 250° F., and at four o'clock the same day it had risen to 310° F.; and the average temperature of the water throughout the week was 273° F. An experiment was performed at Messrs. Romaine and Callender's mill, and the average temperature of the water was 295° F. The scrapers are peculiar to Twibill's machine; they meet round the tubes and have chisel edges, which, by a special arrangement, press against the tube, and actually cut off the soot and tarry matter which accumulates upon the pipes.

Green, of Wakefield, exhibit the finest vertical economiser; the joints of their economiser are all turned and bored socket-joints, "metal and metal" forced together by powerful machinery expressly adapted for the purpose. Their economisers are in operation to 65,000 boilers, representing 2,500,000 horse-power. There is one serious objection to these vertical economisers; that is, if a pipe in the centre burst it is not easy to get at it, and to replace it often involves a loss of several days, whereas in Erskine and Bell's, if one of the spirals get injured it is easily replaced without long stoppage of the works.

Nield's improved fuel economiser is on the same principle as Andrew Bell's. This economiser is arranged in sections, each section consisting of a number of cast-iron ring-shaped pipes, through which the water is caused to circulate. The inlet and outlet passages of each ring are close together; and as this is the sole joint, and the only fixed point in the ring, it is quite impossible that the expansion and contraction of the ring can affect the joint in any way; this is a very important advantage, and is peculiar to this economiser.

Robert and Joseph Ellis, of Liverpool, show some ingenious fire-bars, in which the water, before it enters the boiler, is made to traverse these bars, and is raised to a temperature of 300° F. There are many other appliances for heating the water before entering the boiler; there is the Paxman Water-Heater, in which waste steam from the engine is condensed, and so made to heat another supply of water, and the water is pumped into the boiler at a temperature of 200° .

Goodbrand and Holland show a coal-cutting machine. It is a 27 inch self-acting right or left hand coal cutter, constructed specially for the Wharnccliffe Silkstone Coal Company to undercut their medium hard coal at bottom of seam.

Messrs. Ommanney and Tatham also have Winstanley's coal-cutting machine. This machine is designed for holing in mines which are worked on the wide work or long wall system. It is driven by compressed air, the pressure required being from 20 to 30 lbs. per square inch, according to the nature of the coal to be cut. The height of the machine is 22 inches, and the gauge of the wheels

can be made to suit any ordinary colliery tramway. The cutter holes its own way into the coal, cutting from nothing up to 3 feet or more in depth, the thickness of the groove being 3 inches. The small coal made by holing represents only from 25 to 35 per cent of the quantity of small coal produced by hand holing. The average rate of holing in hard coal, with a pressure of 30 lbs. per square inch, is 25 yards per hour, including stoppages, and this may be considered to equal the work which would be done by at least thirty men in the same time.

Messrs. Hanworth and Horsfall exhibit a self-feeding smoke-burner and fuel-economising furnace. The drawback to it is the complicated arrangement for effecting the object. The bars are moved by egg-shaped wheels, which gives them a forward and backward motion, and the coal is allowed to fall upon them by means of a sloping plane.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

GLASGOW PHILOSOPHICAL SOCIETY. (CHEMICAL SECTION).

Ordinary Meeting, December 22nd, 1873.

Mr. EDWARD C. C. STANFORD, F.C.S., President, in the Chair.

A PAPER, "On Coloured Tapers," by Mr. JAMES MCFARLANE, Assistant to the Professor of Chemistry, St. Andrews, was read. The author detailed a series of experiments which he had prosecuted for the purpose of determining the nature of the colouring matter in the green and red wax tapers. He distinctly ascertained that the former owed their colour to the presence of Scheele's green (arsenite of copper). Their average weight was 2 grms., and the average time occupied in burning was seventeen minutes. Guided by the colour and by the alliaceous odour evolved during combustion, he had no difficulty in pronouncing that arsenic was present; its presence was experimentally determined, and its quantity estimated to be 0.60 per cent of the taper, equal to 0.35 grm., or 5.43 grs. of arsenious acid—quite enough to poison two people if taken directly in the solid form. The red tapers weighed, on an average, about 8.34 grms., and burned seventeen minutes, leaving 3 milligrams of ash totally devoid of metallic appearance. Mercury, existing as vermillion, was found by Reinsch's process, and its quantity was afterwards carefully determined. The amount of mercuric sulphide ultimately collected, washed, and dried, was 1.66 per cent. In one series of experiments, the following results were arrived at—white, yellow, blue, red, and green tapers being experimented upon:—

White.—Perfectly harmless; little ash.

Yellow.—Harmless; coloured with chromate of lead; ash, metallic.

Blue.—Harmless; coloured with ultramarine.

Red.—Highly poisonous, containing 1.93 per cent of vermillion; the tapers very highly coloured; slight ash.

Green.—Poisonous; colour due to arsenic; metallic ash; quantity of arsenic not determined, but probably about 1 per cent.

These tapers burned, on an average, twelve minutes, and in number and quality were much superior to the first, which were of the spiral character. The table is a summary of the results of the examination of the spiral tapers (see next column).

The author afterwards proceeded to consider the effects arising, or which might arise, from the use of coloured wax tapers, and the inhalation of the vapours resulting from their combustion.

	Red.	Green.
Time occupied in burning	12 mins.	17 mins.
Weight	0.93 grms.	2 grms.
Percentage of wax	72.90	71.30
Percentage of wick	25.44	26.89
Weight of wax, per taper	24.85	22.53
Weight of wick, per taper	8.67	8.49
Percentage of arsenious acid	—	1.81
Percentage of vermillion	1.66 to 1.93	—

"On Arsenical Papers." As being closely allied with the subject of the coloured tapers, the same author submitted a communication on arsenical papers, in the course of which he reviewed the theories and cases for and against the alleged unhealthiness of rooms papered with hangings having Scheele's green as one of their colouring matters. He mentioned several cases of severe illness, and even of death, distinctly traceable to the inhalation of the green arsenical compound used in the preparation of the cheaper kinds of paper-hangings.

An interesting discussion followed; one of the speakers was Mr. Patterson, public analyst, Greenock, who stated that he had found green papers in the shop-windows of that town having an extraordinary amount of Scheele's green, and that he had also found it in large quantity in the coloured air-balloons which are sold to children in the streets.

"Anemometers for Flue-Testing." Mr. JAMES MACTEAR, St. Rollox Chemical Works, Glasgow, submitted a short paper on this subject, and illustrated it by exhibiting and describing a number of instruments used in determining the rate of speed of gases in flues and chimneys, more especially those devised by Mr. Thomas Hoey, engineer, Glasgow; Mr. Swan, Newcastle-on-Tyne; and Mr. Fletcher, Inspector under the Alkali Act for the Western District of England. He also exhibited and described another interesting piece of apparatus devised by Mr. Fletcher. Its use is to obtain average samples of the gases in a flue or chimney. The arrangement consists of a fine aspirator, which is worked by the rush of air into the flue, which in its turn works a train of wheels, and puts in motion a small bellows, the action of which is to pump out slowly a portion of the gases, and draw them through the test-solutions. Its use is chiefly for testing hydrochloric acid gas in flues and chimneys, the quantity pumped out being registered by an index, and the amount pumped out in a given time being thus easily found.

NOTICES OF BOOKS.

An Easy Introduction to Chemistry. Edited by the Rev. ARTHUR RIGG, M.A. London, Oxford, and Cambridge: Rivingtons.

THIS work, based, as the Editor tells us in his preface, upon a "First Book of Chemistry" published in America by a Dr. Worthington Hooker, has a very distinctive character. Less formally and avowedly systematic than many introductory works, it shows a curious felicity in illustrating chemical truths by means of familiar facts and well-known incidents. Still a few errors have escaped the notice of the Editor, and may mislead his readers. Thus we find the statement that "it (potassium) is commonly kept in wood-naphtha, a liquid which happens to have no oxygen in it. The naphtha sold in oil-shops and used in lamps is made from coals; there is oxygen in this, and therefore potassium cannot be preserved in such naphtha. With wood-naphtha as a covering to keep out its great friend oxygen, potassium can be preserved pure." We cannot for a moment suppose Mr. Rigg ignorant of the facts that wood-naphtha in its purest state contains 50 per cent of oxygen, and that potassium is kept in native mineral naphtha.

Again we read that plants get from the ground all the nitrogen they need. The researches of some of the most

eminent agricultural chemists have led them to the conclusion that whilst certain plants, such as wheat, derive all or most of their nitrogen from the soil, and require therefore azotised manures; others derive the bulk of their supply from the air, either in the form of ammonia, or, according to Ville, of free nitrogen. These flaws we consider all the more important from their occurrence in a book which we otherwise admire, and we hope to see them removed in the next edition. It would be difficult to name a work more calculated to foster a taste for the study of chemistry in the minds of the young.

Elderhorst's Manual of Qualitative Blowpipe Analysis and Determinative Mineralogy. Edited by H. B. NASON, Ph.D., and C. F. CHANDLER, Ph.D.; fourth edition. Philadelphia and London: Zell.

IT is fortunate that this work presents nothing calling for serious animadversion, since it would be difficult to find the responsible person. In addition to the names mentioned on the title-page we are told that the fifth chapter is a slightly modified translation of Laurent's "Analyse au Chalumeau," that the sixth is nothing but an extract from Prof. v. Kobell's treatise on the discrimination of minerals, and that for the materials of this compilation the author is principally indebted to the works of Plattner, Bezelius, von Kobell, Dana, and Mitchell. Under such circumstances, errors in the methods laid down are not to be anticipated. We think that in recommending coal-gas as the source of heat in blowpipe experiments, attention should have been called to the circumstance that its sulphur may simulate the presence of sulphur in the body under examination.

In his preface to the third edition Mr. Elderhorst states that he has "paid particular regard to the species of minerals occurring in the American Continent; for this reason many less important ores have found a place in the list to the exclusion of others, which, though more valuable, have not hitherto been found in America." This passage, we think, involves a grave error in principle. The author cannot know where his readers may be called upon to examine and distinguish minerals. Neither can he tell that some of the species omitted may not be discovered to-morrow in some portion of the American Continent. Would it not, therefore, be well to furnish the student with the information needed for their recognition? We should unhesitatingly condemn a work of this character, which "paid particular regard" to minerals found in the United Kingdom, the British Empire, or the Eastern Continent.

In the introduction the author makes a limitation which is questionable—"A knowledge of blowpipe operations is less valuable for the chemist by profession than for the mining engineer, the mineralogist, and the geologist." Is it not unwise for the chemist by profession to hand over any of his functions—to wit, the recognition and determination of any body soever—to outsiders?

Apart from these points, and from the indistinct character of the illustrations, we consider the work well-conceived and got up, and we hope it will contribute to the study of a department of chemistry which has been unfortunately neglected.

Preis Courant der Fabrik für Alkohol Präparate. Von C. A. F. KAHLBAUM. Berlin: Schlesische Strasse, 13 and 14.

A PRICE list of chemicals derived from the alcohols arranged under the heads of the methyl, ethyl, propyl, butyl, amyl, and the aromatic series, with an appendix of promiscuous chemicals. For comparison we quote a few of the prices given:—Iodide of methyl, £2 5s. per kilo.; aldehyd (absolute), £1 4s. per kilo.; glycerin at 1.26, 1s. 10d. per kilo.; uric acid, 6s. per 100 grms.; tannin, 7s. 6d. per kilo. It is interesting to see how many substances, which but a short time ago were mere laboratory curiosities, have now become ordinary articles of commerce.

CORRESPONDENCE.

SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

SIR,—Being large consumers of sulphate of ammonia, we are often much inconvenienced by the wet muddy state in which this article is delivered; in by far too many cases manufacturers apparently pack it up, and send it off, direct from the draining-box, without further attempt to dry it. Of course, it is very desirable that sulphate of ammonia should be dry, and it seems strange that sulphate of magnesia and other salts of a similar nature should be dried with the hydro-extractor, while sulphate of ammonia, a much more valuable salt, should be sent into the market in such a crude unrefined state. It would be quite as easy to dry sulphate of ammonia by the hydro-extractor as it is to dry Epsom salts, and it certainly is as desirable that it should be so. Trusting that those alike interested in this matter may have their attention directed to it, and demand that this sulphate be sold and delivered in the same condition as other chemicals, viz., in a perfectly dry state,—We are, &c.,

J. B. S.

FILTERING APPARATUS.

To the Editor of the Chemical News.

SIR,—On procuring a copy of your work, "Select Methods in Chemical Analysis," immediately after its publication, and reading the description therein of Dr. Carmichael's filtering apparatus, I conceived that the use of an air-pump might be dispensed with, provided the pressure on the inside of the bulb were sufficiently diminished. This I accomplished by making a syphon with a very long limb and a short one; on the extremity of the latter is the bulb. The long limb is 39 inches, and the short one 9 inches, which is long enough to reach the bottom of the largest beaker; therefore the difference between the two is 30 inches, so that when the syphon is filled with water the pressure on the outside of the bulb, *a*, is greater than the pressure on the inside by the weight of a column of 30" of water = $\frac{1}{13.2}$ atmospheres = 1.1 lbs. per square inch. The little stopcock, *b*, is useful, for, when shut, the apparatus remains full of water, ready for use. This simple apparatus I find works very well, and filters rapidly, provided the precipitate is allowed to settle well before introducing the bulb into the liquid to be filtered; and its advantages cannot be over-estimated in cases where large quantities of liquid require to be filtered, because when once in operation—with the paper nearly, but not quite, touching the settled precipitate, and a vessel large enough placed to receive the filtrate—the filtration goes on steadily, without requiring any attention, and the precipitate is left in the bottom of the vessel almost dry. By stirring this well with water or other washing solution, allowing to settle, and again filtering, the precipitate can be much more thoroughly washed than on an ordinary filter. For the last washing, the precipitate is transferred to the porcelain or platinum capsule in which it is to be weighed, and the water filtered off from this in the same way.

These syphons are easily fixed for use by causing them to slide between two clamps, one above and one below the stopcock, which are fastened to two narrow shelves fixed against the wall, the upper of which serves to hold the vessels containing the solutions to be filtered. I have a set of six so arranged, with a space of about 6" between each two. By turning round the bulbs of any two towards each other, they meet, and can both be introduced into the same vessel, so as to filter by two syphons, when necessary, instead of by one.

Referring to J. B. Cooke's filtering apparatus, as described in CHEMICAL NEWS, vol. xxvii., p. 261, it may be infinitely improved by substituting the above-described

syphon, cut off at *c*, for the straight tube, the small disc of paper replacing the carded cotton, by passing the end *c* through the stopper of the flask; the advantage being in this case that the flask remains in its upright position, and the weight of ash added to the precipitate, instead of being 100 grs., as in the case of cotton in Cooke's apparatus, will only be about 0.004 gr. It is obvious that the power of the syphon may be increased by increasing the length of the long limb.

Hoping the above may be found worthy of insertion in your valuable journal,—I am, &c.,

JOHN F. KERR, F.R.S.S.A.,
Engineer to the Coppo Gas Company.

Copiapo, Chili, S.A.,
July 21, 1873.

ABNORMAL QUANTITY OF CREAM FOUND IN SOME MILKS.

To the Editor of the Chemical News.

SIR,—Several instances are on record of milks analysed by the Public Analysts yielding abnormally large quantities of cream. Thus three samples, which recently came under my notice, gave 17, 24, and 30 per cent of cream respectively; the natural average being 10 per cent. The vendor of such milks has generally been looked upon as a would be "sly dog," who was under the impression that though he had surreptitiously added a little cream to the sample sold for analysis, the analyst would think only that praise was due to the tradesman who sold such remarkably good milk. I am inclined to think, from a proved case in my own district, that such an individual is maligned. Going further; probably some convictions have ensued, and fines been inflicted for the sale of milk, certified by the analysts to have been "skimmed," or to have been adulterated with water; when, in fact, the vendor has been guiltless of any fraud whatever in the matter.

Suppose one of those large cans filled with new milk, just arrived from the country, to stand for a couple of hours or so in the shop of the retailer; someone goes—it may be an inspector—and asks for a pint of milk. The can is opened, a measure plunged in, and the required quantity withdrawn. The sample so taken will contain an undue proportion of cream; while, if the same process of "baling" out be continued, by the time the can is nearly empty, the remaining quantity of milk will be practically "skimmed." Here then the "early birds" will have got all the cream, while the late ones have scarcely any, and if one of the late samples be submitted officially for analysis, a certificate adverse to the honesty of the milkman may be the result.

Of course it is evident that the persons selling the milk should stir the whole well together before taking any from the bulk; doubtless most of those persons do so, but that some—at any rate occasionally—do not I consider an established fact, their having "got into trouble" being a result of their carelessness,—I am, &c.,

CHARLES H. PIESSE.

Utilisation of Waste Steam.—By the invitation of His Grace the Duke of Sutherland, a number of gentlemen met on Wednesday, the 28th ult., at Stafford House, to see exemplified Mr. J. Berger Spence's "steam-regenerating principle." The invention consists in passing steam at ordinary atmospheric pressure into a solution of caustic soda, which is thereby raised to its own boiling-point. It is proposed to use the heat thus developed to generate steam, the waste steam from an engine-boiler being employed in the first instance to heat the caustic soda. Mr. Spence showed that the effect was absolutely produced by raising a solution of caustic soda to a heat considerably over 212° by means of a jet of steam, but he stated that he had not yet worked out practical details as to the employment of the idea, though he exhibited a sketch of an arrangement of boilers which he considered might render it available.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

OTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, December 22, 1873.

Fermentation: Observations on the Subject of the Procès Verbal of the Last Session.—A continuation of the controversy between M. L. Pasteur and M. A. Trecul.

Chemical Composition of Certain Vegetable Parenchyma.—M. Maudet.—This paper treats of certain interesting phenomena in vegetable physiology. The author finds that the chemical actions which transform fibrose or medullose into cellulose are precisely those which produce the alterations or transformations of the epiangiotic bodies, and the pectic compounds which accompany these kinds of cellulose in the vegetable tissue. May we not infer that this fibrose and medullose are cellulose united, more or less intimately, by capillary attraction to the epiangiotic and pectic bodies?

New Researches on the Preparation of Kermes; Action of Alkaline Carbonates, and Alkaline Earthy Bases, on Sulphide of Antimony.—M. A. Terreil.—The author finds—That the preparation of kermes in the moist way can only be effected with carbonate of soda. That in the dry way the carbonate of potash is more productive than the carbonate of soda. That the carbonate of potash in the moist way has no action upon the sulphide of antimony, and that this character may serve as a test for showing the presence of soda in carbonate of potash. That the hydrate of lime attacks sulphide of antimony in the moist way, whilst the hydrates of baryta and strontia are without action upon it.

Deperdition of Magnetism.—M. Jamin.—The common idea is that, at each temperature, t , steel takes a certain magnetisation, which is less as t is higher, and which it retains on cooling. This is not correct. M. Jamin placed a bar, heated in a sand-bath, so as to receive the blue colour of springs, in a bobbin traversed by a current, and retarded its cooling (by a suitable arrangement). The steel took somewhat less magnetism than if it had been cold. Then he broke the circuit, and, on examining the remanent magnetism with a proof contact, found it much greater than the bar would retain if first cooled (109 grms. instead of 54). Thus the coercitive force does not diminish with heating, but increases. But if the force of detachment be again measured minute by minute it is found to decrease, at first very rapidly, then less so, till in a quarter of an hour it has quite disappeared; and this, whether the bar be kept hot, or allowed to cool naturally. The transition is almost continuous from total magnetisation to remanent, which in time descends to zero. Now re-heat the bar, but to a less temperature. Its total magnetisation (while the current passes) is greater than in the former case; but immediately on breaking the remanent magnetism is less than in that case; on the other hand, it disappears less quickly, and never entirely. Again, begin without heating the bar. The total magnetism is still greater; the remanent (on breaking) still smaller, and invariable with the time.

Note on Magnetism. (Continued.)—M. Gaugain.—A singular fact was observed. When one has magnetised an iron bar as strongly as it is possible to do so with a current of given intensity, the magnetisation may be considerably increased by using currents of the same direction, but of less intensity. This, however, depends on the mode of detaching the armature after interruption of the current; in these cases it was detached by a sudden movement at right angles to the polar faces; if it is detached by sliding along the faces, the feebler currents

do not add to the magnetism developed by the stronger initial current. M. Gaugain considers the detaching of the armature weakens the magnetism; and this, through a shaking (*enbrantement*) of the molecules of iron, which diminishes the coercitive force. He works out a hypothesis of these and other phenomena.

On Phenomena of Gaseous Thermo-Diffusion produced in Leaves, and on consequent Circulatory Movements in the Act of Chlorophyllian Respiration.—M. Merget. (Extract).—When a leaf of *Nelumbium*, with its central concavity under water, is exposed to the sun, bubbles arise from the moistened surface; they cease on complete immersion of the limb. M. Merget found the gas to be atmospheric air, and attributing its production to the sun's heat-rays, he obtained the same phenomenon with an obscure source of heat. The difference of temperature between the exposed parts of the limb and the part protected by the water causes issue of gas from the latter; and for this to rise, spite of the hydrostatic pressure, there must be an impulsive action from the surrounding heated air. Then, if one heat the water on the leaf, so that the temperature becomes uniform, the emission should be stopped; it was so. Also, bubbles on the point of leaving the leaf could even be made to disappear by re-absorption, on hot water being added. Another experiment was, to connect the petiole with a water manometer, and heat equally the upper surface of the limb. The manometer was depressed, indicating a compression of air in the lacunæ, &c. And on removing the manometer, and dipping the petiole end in water, bubbles of gas rose from this, and continued to do so, in some cases, for entire days. There must evidently have entered, by the limb, a volume of air equal to that which issued. This takes place by the stomates; the stoppage of these stopped the liberation of gas. Other gases (in which the leaf was put) were found capable of diffusion, thermo-dynamically, through the limb. The author thinks these are not vital, but purely physical phenomena—of the kind lately studied by MM. Feddersen and Dufour. They probably occur, too, in all plants; a circulatory gaseous current passing from the green parts, which respire, to those which do not respire, while there is a correlative movement of respiration by the former and of expiration by the latter. In aquatic plants the circulation is more extensive.

Moniteur Scientifique, du Dr. Quesneville,
December, 1873.

On Plumbago, Graphite, and its Uses.—This paper, a commentary upon an American pamphlet by Mr. Orestes Cleveland, has no direct chemical interest.

Nature of Chloride of Lime (Hypochlorite of Lime).—M. Goepner.—A voluminous paper, which, as the author threatens, is merely the introduction to more developed details to be given in a memoir in course of preparation. The following points are stated as requiring further elucidation:—The chemical composition of chloride of lime, which is not constant; the variable quantities of chloride of calcium and of quick-lime, the origin and the function of which are still doubtful; the question whether pre-formed hypochlorous acid exists in the chloride. It is well known that chlorides of lime made by one and the same procedure are never identical, their value in active chlorine, capable of bleaching, requiring to be specially determined by analysis in each case. This diversity does not spring from subsequent decomposition, but may be traced when the samples are first drawn from the chambers. On the small scale, these divergencies are still more striking, no two of the samples made by the author in the course of his researches being alike, though all the circumstances appeared identical. The quick-lime employed in the manufacture is always more or less contaminated with carbonate of lime, and the chlorine gas is mixed with variable quantities of hydrochloric and carbonic acids. The author prefers the analytical method of Otto, which,

as he finds, gives results closely agreeing with those of Penot's method.

On Antimony Blue.—Ch. Krauss.—The author proves satisfactorily that this supposed new colour is merely a variety of prussian blue containing no antimony.

Phospho-Tungstic Acid as a Precipitant for Organic Bases.—E. Scheibler.—The bitungstate of soda is dissolved in boiling water with half its weight of phosphoric acid (sp. gr., 1.13), and kept in ebullition for a few minutes. After standing for a few days, the solution deposits fine crystals of a soda salt containing both tungstic and phosphoric acids. Chloride of barium is added to the solution of this salt, the precipitate is washed with hot water containing a little hydrochloric acid, the baryta is removed by means of sulphuric acid, and the filtrate is evaporated, when the phospho-tungstic acid separates out in splendid octahedral crystals. If the monotungstate of soda is used instead of the bitungstate, and the operation conducted otherwise in the same manner, a phospho-tungstic acid is obtained, differing slightly, and crystallising in cubes. These acids, especially the latter, throw down all the organic bases perfectly, even from very dilute solutions. They are very valuable for the first separation of organic bases, but cannot be employed for their final purification, as they precipitate at the same time colouring matters, peptones, &c. The solutions from which the bases are to be thrown down must be previously acidulated with sulphuric acid.

Liebig's Annalen der Chemie und Pharmacie.
November 20, 1873.

Chlorides and Oxychlorides of Sulphur.—A. Michaelis.—The author describes the preparation and properties of the tetrachloride of sulphur. Passing over the hypothetical matter, of which this paper chiefly consists, the actual results may be summed up as follows:—At -22° , S_2Cl_2 takes up chlorine corresponding to the formula SCl_4 . The product thus obtained has the property of a definite chemical compound of entering into double decompositions. The dissociation of SCl_4 increases very rapidly with the rise of the temperature; the dissociation of SCl_2 is far less rapid.

Nature and Constitution of Tannic Acid.—Hugo Schiff.—The author, after summing up the results of earlier chemists, examines the action of oxychloride of phosphorus upon gallic acid. He declares that tannic acid is not a glucoside, and views it as a "first anhydride" consisting of two molecules of gallic acid, and consequently as digallic acid. By the action of arsenic acid, gallic acid is almost entirely converted into tannic acid, without being reduced to arsenious acid.

Correction regarding Carbazolin.—C. Gräbe.—The author corrects certain formulæ in his paper (clxiii., 356).

Capronic Acid contained in the Crude Butyric Acid of Fermentation.—Adolf Lieben.—The author compares the capronic acid obtained by fermentation with that produced synthetically. The differences, he thinks, are the result rather of an impurity in the former kind of acid than a proof of the existence of two isomeric acids.

On the Capronates (Fermentation).—F. Kottal.—In this paper we find an account of the composition and properties of the capronates of lime, baryta, strontia, cadmium, and zinc. None of these salts were obtained in well-defined crystals.

Condensation-Product Obtained from Oxybenzoic Acid.—L. Barth and C. Senhofer.—The new substance, which the authors have named anthraflavon, is, like anthrachrysen, a derivative of anthracen. It cannot be used as a dye-ware, since it produces upon mordanted cloth only a faint yellowish-red shade. Anthrachrysen also does not yield a full madder-red shade, but only a dull yellowish red with a grey cast. Anthraflavon has feebly acid properties, and its saline compounds are not readily obtained in a state of purity.

Phenol-Trisulphuric Acid.—C. Senhofer.—This acid, according to the author's analysis, contains:—

Carbon	18.11
Hydrogen	3.27
Sulphur	24.18

and may be represented by the formula $C_6H_6S_3O_{10} + 3\frac{1}{2}H_2O$. At 105° it suffers incipient decomposition. The author has examined the phenol-trisulphates of baryta, potassa, silver, lead, soda, cadmium, copper, and ammonia.

Orthoxylol Prepared from the Liquid Brom-Toluol Formed from Toluol and Bromine.—Paul Jannasch and H. Hübner.—Orthoxylol and ortho-toluylic acid were obtained by the authors from the mixture of monobrom-toluols produced by the mutual action of bromine and toluol.

On Dichlor-Glycid.—Ad. Claus.—The formula of this compound in a state of purity is $C_3H_4Cl_2$. It is composed of—

Carbon	32.4
Hydrogen	3.6
Chlorine	64.0

Its specific gravity is 1.21. It is soluble in alcohol and ether, but insoluble in water.

Action of Cyanide of Potassium on Dichlor-Glycid.—Ad. Claus.—The products of this reaction are oxycrotonic acid and tricarballic acid.

On Cœnanthyllic Acid and on Normal Heptylic Alcohol.—Harry Grimshaw and Carl Schorlemmer.—The authors examine the cœnanthylates of soda, potassa, baryta, lime, zinc, lead, copper, and silver.

On Trimethyl-Acetic Acid.—A. Butlerow.—The author describes his attempts to find a more productive method of preparing the above-mentioned acid. He finally selects as his starting-point the action of the double cyanide of mercury and potassium with iodide of butyl.

Dichlor-Propionic Ether Prepared from Glyceric Acid.—MM. Werigo and Werner.—The normal action of 3 equivs. of PCl_5 on 1 equiv. of glyceric acid yields a non-crystalline chlor-anhydride, which, in accordance with existing analogies, yields with water dichlor-propionic acid, and with alcohol dichlor-propionic ether. This ether, according to the manner of its decomposition and the nature of the bases thereby employed, yields dichlor-propionic acid, chlor-acrylic acid, or an acid perhaps having the composition of chlor-lactic acid.

Contributions to the Knowledge of Citric Acid.—MM. Hermann and Kämmerer.—The authors, although their researches are not completed, have come upon a number of combinations of the citrates previously unimagined. They have examined the citrates of the alkalis, of the alkaline earths, of zinc, cadmium, iron, copper, lead. They deny that an acid isomeric with the citric can be obtained by the method indicated by Rochleder.

On Citraconate of Baryta.—MM. Hermann and Kämmerer.—A short notice on the preparation and properties of this salt.

Theory of Dissociation.—A. Horstmann.—A lengthy mathematical paper not adapted for abstraction.

A Correction.—E. Linneman.—A short controversial notice in reference to a paper by Butlerow (vol. clxviii., p. 143).

University of Oxford.—Three courses of lectures will be continued during this term—One by the Professor, Dr. Odling, F.R.S., on Organic Chemistry (in detail); one by W. W. Fisher, M.A., on Organic Chemistry (in outline); and one by W. F. Donkin, M.A., on Elementary Inorganic Chemistry. There are also two courses of instruction in practical chemistry—one in quantitative analysis, the other in elementary manipulation for beginners. The Demonstrators are Messrs. Fisher, Donkin, and John Watts, D.Sc.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the treatment of peat for fuel, and in apparatus for the same. Alexander Melville Clark, patent agent, 53, Chancery Lane, Middlesex. (A communication from Jean François Félix Challeton, Paris.) March 14, 1873.—No. 945. This relates—(1). To an improved treatment of peat, the ulmine contained in which is first extracted, and after a preliminary fermentation is disintegrated by means of crushers or stampers. It then undergoes a rasping treatment, and is next sifted to separate the lighter substances. An arrangement of apparatus is described for carrying out the above operations. Steam is next employed to decompose the alkaline ulmates and set at liberty the organic mucilaginous matter of bog plants. After settling, a crystallised ulmine is obtained of considerable density, forming a fuel of standard quality. (2). An oven of special construction is also described for converting the crystallised ulmine into coke or charcoal, the material being supplied in a continuous manner, and subjected to different temperatures (according to the degree of carbonisation required), during its progress through the apparatus, which is heated by the gaseous products of the decomposition, the oils, pitch, and paraffin being also separated in condensing apparatus forming part of the oven.

Improvements in the manufacture of gas for illuminating and other purposes. Isham Baggs, of High Holborn, in the county of Middlesex, practical chemist. March 20, 1873.—No. 1046. Mixtures of hydrogen and carbonic acid gases, or of hydrogen and carbonic acid gases and carbonic oxide, however the same may have been produced or eliminated, through a heated "scrubber," the latter being placed vertically and filled with pieces of charcoal, coke, iron, or other suitable substances in such a manner that the carbonic acid which passes by filtration through the heated mass is converted into carbonic oxide, whilst the hydrogen and carbonic oxide (when the latter is contained in the mixture) pass by unaffected in their chemical character. Instead of merely purifying the gas as above described, the generation and purification thereof in one process is preferred. Two or more vertical scrubbers charged with suitable carbonaceous materials are arranged as a series, and the whole heated to a high degree. Steam is admitted to the first of the series, alternately ascending and descending, or *vice versa*, through the same. The scrubbers are heated, by preference, by means of the hot blast.

Improvements in manures. Peter Jensen, engineer and patent agent, 89, Chancery Lane, Middlesex. (A communication from Egmund Julius Erichsen, of Copenhagen). March 21, 1873.—No. 1055. Mixing superphosphate manures with silicate of soda or silicate of potash, or mixtures of them, in order to dry off the manures.

Improvements in the preparation of powders for the destruction of animal and vegetable parasites, applicable also as disinfectants and deodorisers. Charles Roberts, F.R.S.C., 2, Bolton Row, Mayfair, Middlesex. March 26, 1873.—No. 1121. This Provisional Specification describes impregnating powdered substances with sulphurous acid.

Improvements in the manufacture of pyroxyline to be employed as an explosive material and in the manufacture of collodion; also in the treatment thereof when it is to be employed in the solid state for dental and for other purposes. Dana Bickford, New York, but at present of 35, Southampton Buildings, Middlesex. (Partly a communication from Dr. Spooner, New York, and partly a communication from the Pyroxyline Manufacturing Company, Boston, Mass.) March 29, 1873.—No. 1170. The invention consists in the manufacture of pyroxyline from the esculapius weed to be employed as an explosive material, and in the manufacture of collodion; also in the treatment thereof when it is to be employed in the solid state for dental and for other purposes.

MEETINGS FOR THE WEEK.

- MONDAY, Feb. 9.—Medical, 8.
 — London Institution, 4.
 — Geographical, 8.30.
 TUESDAY, 10.—Royal Institution, 3. Prof. Rutherford, M.D. "On Respiration."
 — Civil Engineers, 8.
 — Anthropological, 8.
 — Photographic, 8. Anniversary.
 WEDNESDAY, 11.—Society of Arts, 8.
 THURSDAY, 12.—Royal Institution, 3. Prof. P. M. Duncan, F.R.S., "On Palæontology, with reference to Extinct Animals and the Physical Geography of their Time."
 — Royal, 8.30.
 — Royal Society Club, 6.
 FRIDAY, 13.—Royal Institution, 8; Weekly Evening Meeting. Dr. Doran, "On the Opponents of Shakespere", 9.
 — Astronomical, 3. Anniversary.
 — Quekett Microscopical Club, 8.
 SATURDAY, 14.—Royal Institution, 3. Mr. R. Bosworth Smith, "On Mohammed and Mohammedanism."

UNIVERSITY COLLEGE, LONDON.

Organic Chemistry.—Professor Williamson's Course of Lectures on this subject will begin on Monday, February 9th, and will occupy about six weeks, the class meeting every week-day, except Saturday, from 11 to 12. Fee, £2 2s.

ANALYTICAL CHEMISTRY is taught in the Birkbeck Laboratory, which Students may enter at any period of the session.

JOHN ROBSON, B.A., Secretary to the Council.

Professor Tennant's Lectures on Rocks and METALLIC MINERALS at King's College are given on Wednesday and Friday mornings from 9 to 10 o'clock, and on Thursday evenings from 8 to 9. The lectures commenced Thursday, January 22nd, and will be continued to Easter.

PRIVATE INSTRUCTION in GEOLOGY and MINERALOGY can be had by Professor TENNANT at his residence, 149, Strand, W.C., by those unable to attend public lectures.

TEXT-BOOKS OF SCIENCE, EDITED BY T. M. GOODEVE M.A., AND C. W. MERRIFIELD, F.R.S.

On Saturday, February 7, will be published, in small 8vo., cloth, with numerous Woodcuts, price 3s. 6d.

Organic Chemistry, Introduction to the Study of; the Chemistry of Carbon and its Compounds. By HENRY E. ARMSTRONG, Ph.D., F.C.S., Professor of Chemistry in the London Institution.

London: LONGMANS, GREEN, and CO., Paternoster Row.

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THE CHEMICAL NEWS.

VOL. XXIX. No. 742.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

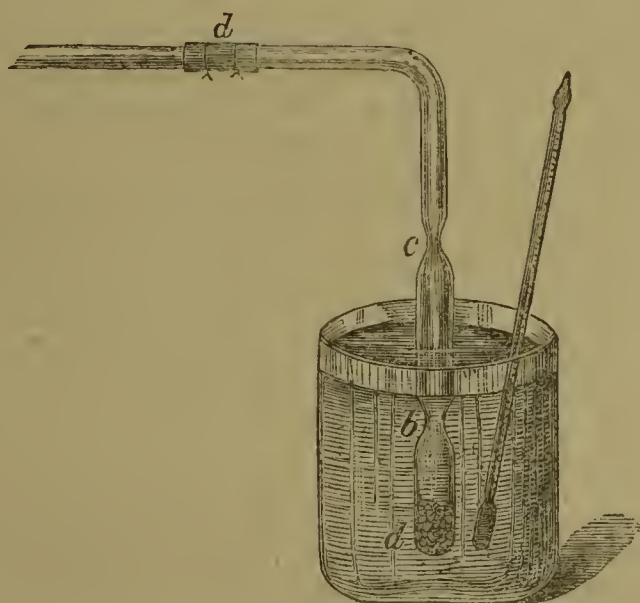
(Continued from p. 66).

Oxalic Acid.

COMMERCIAL purified oxalic acid is gently heated in a flat dish until the water of crystallisation is removed. Bibulous paper is then placed over it, a paper cap over that, and the heat is increased until the oxalic acid sublimes. The sublimed crystals are removed from the inside of the paper cap, and introduced into the lower portion, *a*, of the glass apparatus shown in Fig. 9. The tubes are contracted at *b* and *c*, and the end *d* is connected by means of an india-rubber connector with the Sprengel pump. The air is now completely exhausted from the apparatus, and it is immersed in a paraffin-bath to a little above the first contraction, *b*; a thermometer is also immersed in the bath.

The temperature is first raised to 200° F., and the exhaustion continued until all moisture disappears from the inside of the tube. The bath is then gradually raised to

FIG. 9.



250°, and kept at that temperature till the oxalic acid has risen in vapour and condensed in the wide portion of the tube between *b* and *c*. The paraffin-bath is then taken away, and when the tube is cold it is removed from the pump by applying a blowpipe-flame to the contraction *c*; this being repeated at *b*, leaves the sublimed oxalic acid perfectly pure in the bulb *b*, and in a vacuum.

In this apparatus oxalic acid commences to sublime below 200° F. If the temperature of the paraffin-bath be kept below 278° F., no permanent gas is evolved, and no formic acid is obtained; above that temperature, the barometer-gauge of the pump commences to sink; but the mercury descends very slowly until 330° is reached, when the decomposition of the oxalic acid into formic and carbonic acids becomes more rapid.

Sulphuric Acid.

After many attempts to prepare sulphuric acid free from arsenic by the distillation at a red heat of alkaline bisulphates, by dissolving sulphuric anhydride in water, and by decomposing sulphate of silver with sulphuretted hydrogen, I finally adopted Bloxam's method of preparing it by means of sulphurous and nitrous acids (*Fourn. Chem. Soc.*, vol. xv., p. 52).

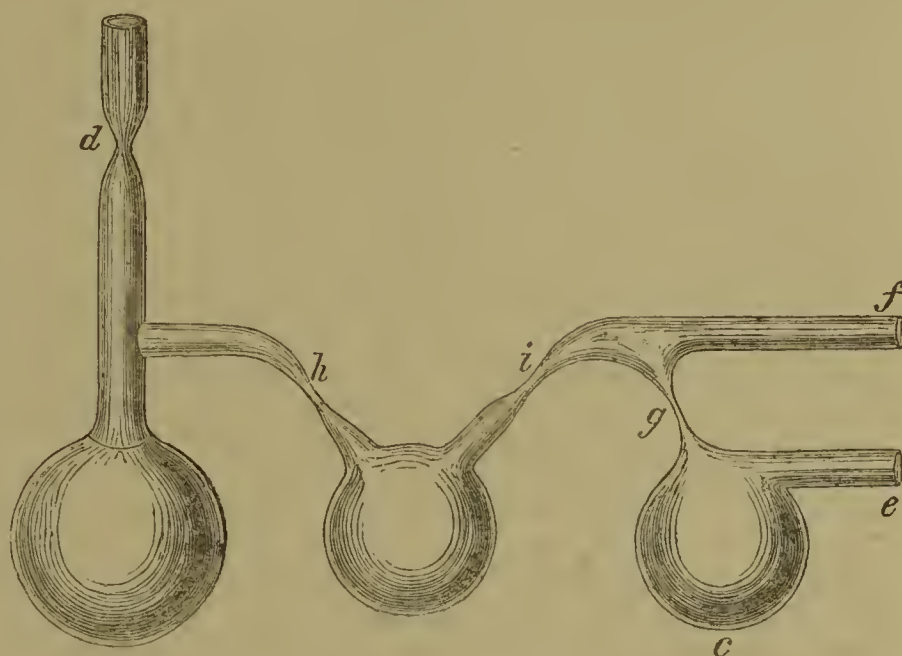
The sulphurous acid is evolved from well-crystallised sulphite of sodium by the action of sulphuric acid, keeping the temperature as low as possible. The current of gas is first passed through a washing-bottle of water containing a little oxide of silver in suspension (which becomes converted into sulphite of silver, and then into a mixture of sulphate of silver and metallic silver), then through two U-tubes filled with small pieces of pumice-stone moistened with water. The pumice-stone should be previously purified from chlorides and fluorides by Stas's method of igniting it twice with sulphuric acid.

The nitrous acid is prepared by gently heating together nitrate of potassium, ferrous sulphate (both purified by repeated crystallisation), and dilute sulphuric acid.

The sulphurous acid and nitrous acid are conducted simultaneously by tubes into a large glass globe, a third tube serving for the introduction of steam. The three tubes pass into the globe through a glass plate in which three holes have been perforated. The glass plate and mouth of the glass globe are fitted to each other by grinding. No lute being used, sufficient air finds its way into the globe to keep up the reaction. By regulating the ingress of nitrous acid, of sulphurous acid, and of steam, the operation can be carried on continuously for many hours.

The condensed liquid is next introduced into an

FIG. 10.



apparatus blown from hard German glass, as shown in Fig. 10. *a*, *b*, and *c* are three bulbs about 3 inches diameter. The dilute sulphuric acid is introduced into the bulb *a* by means of the neck *d*, which is then sealed before the blowpipe at the contracted part. The end of the tube *e* is then connected with the Sprengel pump, the end *f* temporarily stopped up, and the whole is exhausted. The bulb *b* is immersed in a water-bath kept at the boiling-point, and, *a* being gently heated, the excess of water in the sulphuric acid goes off, and partly condenses in the bulb *c*, which is kept cold, and partly becomes carried down through the pump by the falling mercury.

Concentration of the acid proceeds rapidly; and as soon as all excess of water has been thus eliminated, and the gauge of the pump shows that only aqueous vapour is present, the bulb *c*, containing water, is removed by applying a blowpipe-flame to the contracted portion of the tube *g*. Air is now admitted, the tube *f* is connected with the Sprengel pump, and exhaustion again proceeded with. The bulb *b* is now kept cool, and the bulb *a* heated in a sand-bath. The atmospheric pressure must not be altogether removed, or the bumping of the acid in *a* will be very violent. If the exhaustion is such that the mercury in the gauge stands at about 15 inches, the oil of vitriol distils quietly from the bulb *a* to *b* without bumping; but if the exhaustion is raised to above 16 inches, the ebullition becomes percussive. When most of the acid has distilled over into *b* the source of heat is removed, the

* A Paper read before the Royal Society June 20, 1872.

mercury in the pump is again allowed to run until a vacuum is produced, and the bulb *b*, containing pure distilled sulphuric acid, is sealed up and removed by the application of a blowpipe-flame to the contracted portions of the tubes *h* and *i*.

Carbonic Acid.

Calc-spar is dissolved in pure hydrochloric acid. An excess of the spar is added, and the solution warmed; to it is added lime-water made from pure or nearly pure lime, until the solution is alkaline to test-paper. This solution is filtered, and after heating it to at least 160° F., precipitated with carbonate of ammonium.* The carbonate of calcium thus precipitated is thrown on a filter and well washed with pure water. Thus prepared, the carbonate of calcium is a dense powder and perfectly pure; or, if it contain any impurity, it will be a trace of carbonate of barium or strontium, which in no way interferes with its use in preparing carbonic acid.

The dense granular carbonate of calcium is then strongly compressed in a steel diamond mortar into the form of coherent lumps. These lumps are introduced into a Wolff's bottle, and pure oil of vitriol poured over them. A continuous and not too rapid evolution of carbonic acid commences, and is continued for some time. When the disengagement of gas becomes sluggish, a few drops of water restore the action. Large bottles must be used for this operation to avoid the inconvenience of the foaming to which the acid is liable.

The carbonic acid is washed by passing through solution of sulphate of silver containing carbonate of silver in suspension to the consistency of thin cream, and it is then passed through a U-tube containing purified pumice-stone moistened with oil of vitriol.

Ammonia.

Ammonia is prepared in two ways:—

(1). Nitrate of potassium heated to incipient decomposition, and then crystallised three times from pure water, is dissolved to saturation in water, and put into a retort. Sodium amalgam containing about 1 per cent of sodium is then added, and the whole allowed to stand in a cool place for twelve hours. Gentle heat being now applied to the retort, ammonia (from the reduction of the nitric acid) is driven over with the first portions of water, and is condensed in a receiver cooled with ice. The temperature of the liquid in the retort is not allowed to rise to the point of ebullition, and the operation is stopped when one-fourth of the liquid in the retort has distilled over.

(2). Ammonia is also prepared by a method recommended by Professor Stas. Nitrite of potassium is mixed with strong solution of caustic potash, and the liquid poured into a large glass balloon containing a mixture of zinc (free from carbon)† and iron wire, which has been first oxidised by heating in the air and then reduced by hydrogen. After standing for seventy-two hours, the liquid is decanted from the residue into a retort, which is then gently heated on a sand-bath. The arrangement for condensing the ammonia consists of two flasks fitted up as Wolff's bottles containing pure water. The distillation is effected very slowly below the boiling-point of the liquid, and the condensers are cooled with ice.

Hydrogen.

The method pursued in the preparation of pure hydrogen is as follows:—The gas is generated in one of a series of Wolff's bottles by pouring warm caustic potash over a

mixture of granulated zinc and iron scraps. The gas thus generated (the method is thus due to Runge, *Pogg. Ann.*, vol. xvi., p. 130) is inodorous. It is next passed into another Wolff's bottle containing protochloride of tin; then through tubes containing pumice-stone moistened with a concentrated solution of pyrogallic acid in caustic potash, and again through tubes containing pumice moistened with sulphuric acid, the object in passing the gas through the protochloride of tin and through the pyrogallic acid being to remove the oxygen diffused into the apparatus from the atmosphere.

Thallium.

It may not be out of place here to note the most usual sources of thallium as it is ordinarily prepared.

Thallium is a very widely distributed constituent of iron and copper pyrites. Upon examining a large collection of pyrites from different parts of the world, it was found present in more than one-eighth. It is not confined to any particular locality. Amongst those ores in which it occurs most abundantly (although in these cases it does not constitute more than from the 100,000th to the 400,000th of the bulk of the ore), may be mentioned iron pyrites from Theux, near Spa in Belgium, from Namur, Philipville, Alais, the south of Spain, France, Ireland, Cornwall, Cumberland, and different parts of North and South America; in copper pyrites from Spain, as well as in crude sulphur prepared from this ore; in blende and calamine from Theux; in blende, calamine, metallic zinc, sulphide of cadmium, metallic cadmium, and cake sulphur from Nouvelle-Montagne; in native sulphur from Lipari and Spain; in bismuth, mercury, and antimony ores, as well as in the manufactured products from these minerals (frequently in so-called pure medicinal preparations of these metals); in commercial selenium and tellurium (probably as selenide and telluride).

Thallium is likewise frequently present in copper and commercial salts of this metal. In Spain a very impure copper is prepared in the following way:—Copper pyrites is allowed to oxidise in the air, and the resulting sulphate of copper is washed out; scrap iron is now placed in the liquid, which causes the copper to precipitate in the powdery state. The metal is then collected together, dried, strongly compressed, and heated to the melting-point. It is brought over to this country in the form of rectangular cakes, weighing about 20 lbs. each, and is called "cement copper." The sulphide of thallium, oxidising to sulphate along with the sulphide of copper, is washed out by the water, and precipitated with the copper by the iron. The two metals alloy together.

Thallium is present in tolerable quantity in lepidolite from Moravia, and in mica from Zinnwald. It has likewise been found in the deliquescent "sel à glace" from the mother-liquors of the salt-works at Nauheim. This consists of a mixture of the chlorides of magnesium, potassium, and sodium, with relatively considerable quantities of chlorides of rubidium and caesium, and sensible traces of chloride of thallium. Thallium is also met with in the mother-liquors in the sulphate of zinc works at Gozlar, in the Harz.

Nordenskjöld has found in the copper mine of Skrikerum, in Norway, a native selenide of copper, silver, and thallium, containing about 18 per cent of thallium. It occurs in the form of lead-grey compact masses, having the hardness of copper glance and a sp. gr. of 6.9. This mineral has been named *Crookesite* by its discoverer. From the general association of selenium, copper, silver, and thallium in iron and copper pyrites it is probable that the thallium is here present in the form of Crookesite disseminated through the mass.

The optical process of detecting thallium in a mineral is very simple. A few grains of the ore are crushed to a fine powder in an agate mortar, and a portion taken up on a moistened loop of platinum wire. Upon gradually introducing this into the outer edge of the flame of a Bunsen's gas-burner, and examining the light by means of a spectro-

* This precaution, which was first suggested by Professor J. Lawrence, of Louisville, must not be overlooked, as it is desirable to obtain the precipitated carbonate of calcium as dense as possible. If the carbonate of ammonium be added to the cold solution, the precipitate, at first gelatinous, will ultimately become much more dense and settle readily; the same is true if the mixture be heated after the addition of the carbonate of ammonium; but in neither case will it be as dense as when the carbonate is added to the hot solution of chloride of calcium.

† Zinc is obtained free from carbon by fusing it with a mixture of carbonate of sodium and nitre.

scope, the characteristic green line will appear as a continuous glow, lasting from a few seconds to half a minute or more, according to the richness of the specimen. By employing an opaque screen in the eyepiece of the spectro-scope to protect the eye from the glare of the sodium line, thallium may be detected in half a grain of mineral, when it is present only in the proportion of 1 to 500,000. The sensitiveness of this spectrum reaction is so great that no estimate can be arrived at respecting the probable amount of thallium present.

Many samples of commercial sulphuric acid and yellow hydrochloric acid contain thallium. The source in these cases is evidently the pyrites used in the sulphuric acid works.

(To be continued.)

THE CHEMICAL CONSTITUTION OF CITRIC ACID AND ITS NUMEROUS DERIVATIVES, CRITICALLY EXAMINED AND INTERPRETED FROM THE STANDPOINT OF THE "TYPO-NUCLEUS" THEORY.

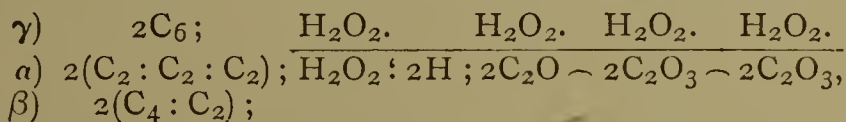
By OTTO RICHTER, Ph.D.

(Concluded from page 43).

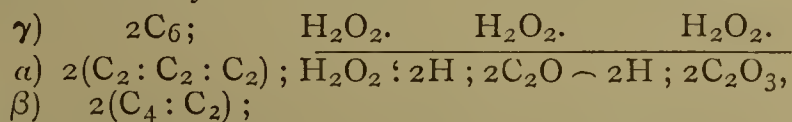
PART II.

On the Effects of Heat upon the Ordinary Citrate of Water, as also on the Effects of Oxidising and Reducing Agents upon the three Pyro-Citric Isomerides.

(1). Let us, in the first place, inquire into the effects of heat upon the ordinary citrate of water. When this compound is heated up to a certain point, it splits up into 2 molecules of water and the so-called aconitate—



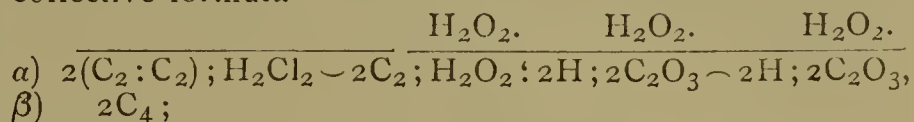
which, by its formula, ought to occur in three isomeric forms, and is thus shown to be identical with the *d* ortho-citrate of the third scheme. When the aconitate is heated in its turn it resolves itself into carbonic acid and a mixture of two isomeric water-salts, which correspond to the itaconic and citraconic acids of our handbooks; if we add to these a third isomeride, which passes under the name of mesaconic acid, the whole of these three varieties of pyro-citrate may be included in the collective formula—



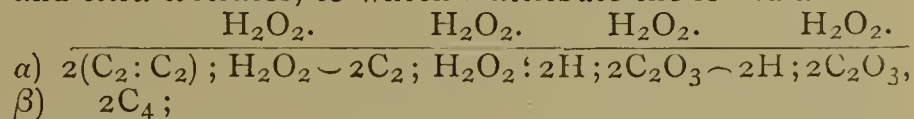
which is thus shown to be identical with the *c* meta-citraconite of the second scheme.

It is, moreover, of importance to point out that the three pyro-citric isomerides belong each and all to the class of meta water-salts, while their corresponding ortho modifications remain yet to be discovered. Now I have good reason for believing that the *a* variety answers to the itaconate, the *β* variety to the citraconate, and the *γ* variety to the mesaconate, and I ground my belief, amongst others, upon the fact that the itaconate is directly convertible by heat into the citraconate, and the latter into the mesaconate; with this difference, however, that the calorific agency requires to be combined with the catalytic agency of substances like nitric or hydriodic acid, whereas every attempt of directly converting the itaconate into the mesaconate, and *vice versa*, has invariably proved a failure. But since, as my formula implies, these isomeric relations are due to certain typical differences in the mode of condensation, which the constituents of the complex carbon adjunct are liable to experience, it stands to reason that the *a* arrangement (where the three elementary carbon molecules are placed in juxtaposition) requires to pass first of all into the *β* arrangement (where two of these carbon molecules are condensed into one, while the third remains in *statu quo*) before it can merge into the *γ* arrangement (where all the three carbon molecules are condensed into one).

(2). Let us, in the second place, contemplate the effects of oxidising and reducing agents upon the three pyro-citric isomerides. According to Carius, when the three pyrocitric varieties are treated with hypochlorite of water, $2H_2O_2 \cdot 2Cl_2O_2$, the resulting products are the so-called ita- and citra-chloromalates, to which I shall assign the collective formula—

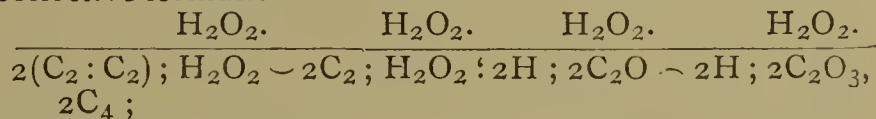


which is based upon the following train of reasoning:—I suppose that the formous acid principal of one molecule of pyro-citrate becomes oxidised at the expense of the acid constituent of the hypochlorite, while the liberated chlorine re-unites with the two molecules of basic water. The resulting two molecules of chloro-peroxide of hydrogen, $2H_2Cl_2O_2$, are then made to surrender their oxygen to the formous acid principal of a second molecule of pyro-citrate, while the two molecules of hydrochloric acid which remain, by instantly transposing with the colligated alcohols of the the two newly-formed oxy-pyro-citrate of water molecules, give rise to the corresponding chlorides; at the same time, the two liberated water molecules, instead of being eliminated, appropriate a molecule of formen from the complex carbon adjunct, &c., with final production of the afore-mentioned ita- and citra-chloromalates. It is worthy of note that, when the solutions of their salts are boiled, they give rise to the so-called ita- and citra-tartrates, to which I attribute the formula—



because the metamorphosis is evidently accomplished by the previously formed hydrate of the base transposing with the colligated chloride. It will be seen that this formula is identical with the *b* meta-citraconéite of the second scheme.

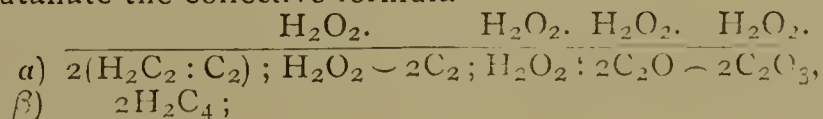
Again, if we treat the water-salts of these acids with zinc, the metal becomes oxidised at the expense of the formic acid principal and the newly-formed hydrate of zinc, by transposing with the colligated chloride, gives rise to the ita- and citra-malates of our handbooks, whose collective formulæ—



agrees entirely with the *b* meta-citraconite of the second scheme.

Theoretically, the reducing action of sodium amalgam or hydriodic acid on the three pyro-citric isomerides ought to yield three varieties of meta-pyrotartrate; but practically the reaction appears to culminate in the production of the ordinary pyrotartrate only. This unexpected deviation from what may be termed the normal course of the reaction is readily explained on the hypothesis that the three looked for varieties are actually formed in the first stage of the process, but that in the existing conditions the *a* and *γ* varieties are first changed into the *β* variety, which, by the method of orthogenesis, is ultimately converted into the ordinary pyrotartrate.

I may observe here that the *a* variety of this compound seems to have recently been obtained by Dittmar, viz., by subjecting Ritthausen's glutamate to the reducing action of hydriodic acid. The desoxyglutamate, as it is called by its discoverer, differs considerably from the *β* pyrotartrate, not only in the smaller size of the crystals, but likewise in the melting-point, which is several degrees lower, while it resembles the *β* variety in its readiness to split up into 2 molecules of water and the anhydride. I have, therefore, no hesitation in attributing to the aforesaid glutamate the collective formula—



where the α variety corresponds to Ritthausen's glutamate; while the β variety, from which the ordinary pyro-tartrate ought to be obtainable with the aid of reducing agents, remains yet to be discovered. Another point of interest which the glutamate possesses consists in its isomeric relations to the ita- and citra-malates, on the one hand, and to the oxy-pyrotartrate on the other hand, for a comparison of their formulæ shows that these three isomerides are genetically connected with each other as iso, meta, and ortho modifications.

In drawing these lines to a close, I may be permitted to express a hope that this paper, in conjunction with those that precede, will not be thought unworthy of a careful perusal and searching examination.

PROFESSOR BISCHOF ON FRANKLAND AND ARMSTRONG'S METHOD OF WATER ANALYSIS.

PROFESSOR GUSTAV BISCHOF, of the Young Chair of Technical Chemistry, Glasgow, read a paper on "Frankland and Armstrong's Method of Water Analysis," at a recent meeting of the Chemical Section of the Philosophical Society of Glasgow. Considering the conflicting evidence at present existing in regard to that method, it appeared to Professor Bischof desirable to test it in several ways in which, so far as he was aware, it had not been tested. He divided the method into three stages:—1. The measurement of the gases. 2. The combustion. 3. The evaporation of the water. The accuracy of each stage was tested separately, in order to ascertain to which stage any inaccuracies might be due.

1. Pure carbon dioxide and nitrogen gases were mixed in about the same ratio as that in which they occur in water. The mixture was determined repeatedly by measuring their total volume, and the volume of the two gases separately, all the reagents being introduced into the laboratory vessel required for the analysis. Such quantities of carbon and nitrogen as occur in pure water could be readily measured to within 0.69 per cent of the actual quantity present. There was only one unaccountable exception to this rule amongst a large number of measurements. When measuring 0.76 c.c. of the mixture, the author found 93.58 per cent of carbon and 6.42 per cent of nitrogen, instead of 89.02 per cent of carbon and 10.98 per cent of nitrogen. His first supposition, that this might be due to an absorption of the nitrogen by an unusually large proportion of the reagents employed, had to be abandoned; for, after leaving 0.08 c.c. of nitrogen in contact with a large excess of the reagents over-night, its volume remained perfectly unaltered. He was therefore strongly inclined to attribute this one incorrect result to an error in reading off the divisions of the measuring-tubes. He found, however, that it was of no consequence, in measuring very small quantities of gas, whether the solution of the reagents were allowed to pass more or less into the horizontal thermometer-tube connecting the laboratory vessel with the measuring-tubes, and that it made a considerable difference if the gas were passed in one instance on to the right, and in another to the left, side of the first stopcock, especially if the latter bulged out instead of the bore of the thermometer-tube remaining equal throughout. As it was difficult to stop the inflow always at exactly the same place, a few graduations on the horizontal tube might allow for a connection in the case of very small volumes of gases. In connection with this part of his subject, the author directed the attention of the Section to an ingeniously-constructed pipette that he was in the habit of using; and he proceeded to say that, in measuring gases resulting from combustions, carbon monoxide was, in his experience, more frequently present than should be expected from Sutton's description, and he therefore always tested for it. The gas resulting from the combustion of the residue, after the evaporation

of an impure water, was next divided into several portions, which were, without exception, determined with the greatest accuracy, as was evident from the relative proportions of carbon and nitrogen obtained.

2. The author stated that he made the copper spirals used in the combustion-tube by winding evenly fine copper wire round a central wire. He preferred having this, as also the copper oxide, tight in the combustion-tube. As the latter might choke, he always allowed a drop of water to fall on the sealed end of the combustion-tube after the combustion had been finished, and the test-tube containing the gas removed. The falling of the mercury in the delivery-tube of the air-pump at once indicated whether or not the combustion-tube was choked. However fine and tight the copper oxide might be, choking was found to take place very rarely. The residue from the evaporation was divided into several portions, which were burnt and measured separately, and the results examined.

3. Like quantities of Loch Katrine water were evaporated under the same and under different conditions as to temperature, but always under the glass shades; and the author thought he might conclude from the results thus obtained that the temperature and the time allowed for evaporating the water were of some consequence, inasmuch as a somewhat larger proportion of organic nitrogen was obtained if the evaporation were finished in a comparatively short time—say, a litre in about twenty hours—than if, at a lower temperature, five or six days were allowed. He could not explain this in any other way than by supposing a fermentation to set in, thereby altering the nitrogenous organic matter; that was not impossible, as the sulphurous acid added acted as an antiseptic. However, as Dr. Frankland did not add that acid to the contents of the evaporating-dish, but only, if required, to the flask in which it was boiled and kept, such a fermentation might set in if the water, after the sulphurous acid had been driven off, were kept for a long time at a temperature of, say, about 70° C., without adding any new portion from the flask.

Three questions still remained for further consideration, namely—

1. The action of any free acid that might be formed in the organic matter during the evaporation.
2. The estimation of the nitrates and nitrites.
3. Whether the results were reliable in analysing very pure waters.

EXHIBITION OF APPLIANCES FOR THE PRODUCTION AND ECONOMICAL USE OF FUEL, IN CONNECTION WITH THE SOCIETY FOR THE PROMOTION OF SCIENTIFIC INDUSTRY, MANCHESTER.

(Continued from p. 69).

SOME experiments were performed at Lacy Brothers, Callis Mill, near Hebden Bridge, upon two of Galloway's New Patent Boilers, 28 feet long, 7½ feet diameter, and working at 90 lbs. pressure, one of them fired by hand, the other by the self-feeding furnace. The results of tests show a gain of 15 per cent in favour of the self-feeder.

Results of Tests, January 22, 23, 1874, at Messrs. Lacy's.

Firing.	Time, in hours.	Coals Used.		Water Evaporated.	Pounds of Water
		cwts.	lbs.		Evaporated per lb. of Coal.
Hand-fired ..	10.5	75	0	7150	8.42
Self-feeding ..	10.5	69	26	7700	9.93

William Young, Brothers, Queen Street, London, show a Smoke Preventer with spiral bars, for every description of furnaces, grates, and stoves. By means of this apparatus the fuel is introduced at the bottom of the fire, under the burning coals, and thus the production of smoke

is prevented. The smoke preventer is composed of spiral bars mounted on an axis, which is moved by hand or machinery each time coals are required; in an ordinary fire-grate, there is a small trough at the bottom, in which works an axis carrying two vanes of fire-bars. The coal is put into the trough, and the poker is used, not to poke the fire, but to turn the fire-bars round, thus turning the fresh coal under the ignited coals.

Piercy, of Birmingham, exhibit an apparatus called a Mechanical Stoker, patented by Dillwyn Smith. It is a very ingenious arrangement for feeding the furnace mechanically. In front of the fireplace is a cylinder about 4 feet long and 8 in diameter; up the top of this is a hopper which will hold about 5 cwts. of coal. In the cylinder revolves two Archimedean screws, one right and one left, which carries the coal into chambers, one underneath each screw. In these chambers revolve two fans, which throws the coal the whole length of the furnace, the quantity of coal being regulated by the requirements of the boiler.

Sudlow, of Oldham, exhibits a Rotary Engine, the advantages of which are as follows:—It obviates the dead points or centres of the crank, and consequent ever-varying leverage, the steam acting at an uniform distance from the centre throughout its entire travel. It also gives an increased longitudinal capacity, wherein to expand high pressure steam without incurring pressure, as in the case of compound engines; also, where necessary, the fly-wheel can be entirely dispensed with.

Reese and Gledhill show Wright's Patent Movable Fire-Bar. The rapid and complete manner in which they operate upon the combustible matters used decreases the formation of clinker or slag, by removing the refuse while in a state of dust before it has time to cake into a clinker. By their peculiar advancing and retiring action, the slag that is formed at the extreme back of the furnace is brought, with every successive action of the bars, and deposited on the dead-plate, or mouth of the furnace. This is an advantage of the greatest importance, as the removal of slag from the extreme back of furnaces has always been attended with great difficulty and the periodical destruction of the fire. A thorough and complete combustion is effected by the breaking up and removal of the slag, and consequent free admission of air between the bars, and a large saving is effected in the usual consumption of coal.

Mr. Gall, of Halifax, shows a Patent Self-Acting Smoke Preventer, with the recommendation that it will reduce the smoke emitted from the chimney by seven-eighths; and should this result not be attained the purchaser may, within one month, return the Preventer to the patentee, and no charge whatever will be made.

Dingley and Son, of Leicester, exhibit Lake's Coal Economiser, which, according to the statement of the patentee, will save from 10 to 15 per cent on stationary boilers, and from 20 to 25 per cent on multitubular boilers. This arrangement consists of a conical, fluted, or corrugated valve, applied to the rear end of the tube and capable of being adjusted as required; the openings round the valve, being the outlet for the draught, and which are proportioned to the area over the bridge, cause the fire to be kept in close contact with the plates around and throughout the entire length of the tube, ensuring more perfect combustion and equal distribution of the heat within the boiler. It is applied without in any way altering the boiler or interfering with present draught.

Howard's, of Bedford, show their celebrated Safety Boiler; and among the leading features of this boiler are, safety (every boiler is tested to three times its working pressure, and the bursting pressure of the tubes is at least 1500 lbs. per square inch), great simplicity of parts, facility of repairs, and durability. In the Howard Safety Boiler there are neither seams nor rivets, and no joint is exposed to the direct action of the fire; the tubes are counterparts of each other, and every part is made on the interchangeable principle; and it is more readily accessible,

both internally and externally, for thorough inspection and cleaning than almost any other form of boiler—high pressure steam, with economy of fuel. With this boiler a pressure of 120 to 140 lbs. per square inch is more secure than ordinary boilers working at 50 lbs., while experience has shown that on the great question of economy of fuel the hopes entertained that the higher pressure of steam would, under proper conditions, lead to an important saving of coal have been realised.

A similar boiler is shown, and called the Safe and Sure Boiler, by the Patent Steam Boiler Company, of Birmingham. They claim for their boilers absolute safety from explosion; this advantage is obtained by the sub-division of steam and water in small tubes tested to a pressure of 500 lbs. to the square inch. If a tube should burst, the only result would be a rush of steam and water into the furnace, a sudden lowering of the steam pressure, and the extinction of the fire. A boiler is often thrown aside as useless nine-tenths of which is practically good, but from the remaining tenth having failed the whole has to be rejected; with this boiler that one-tenth could have been replaced by a new one in perhaps less than two hours, when the whole would have been as good as ever. The nature and disposition of the heating surface in this boiler are such as cannot fail to fully utilise the heat applied, while the internal arrangements are such as entirely prevent the escaping gases becoming much above the temperature of the steam, and ensures, with an ordinary amount of attention, perfect consumption of the smoke.

Stanley, of Sheffield, shows his Patent Furnace for Smelting Ore. The advantages of these furnaces are, in the first place, they affect a saving of from 25 to 30 per cent in fuel. The use and expense of grate-bars are dispensed with, as these furnaces have closed fire-places formed in brickwork; they make from 80 to 90 per cent less ash than open fire-grate furnaces, the workmen have much less labour in working these furnaces, and the heat is quicker and more under the control of the furnace men.

Bailey and Co., of the Albion Works, Salford, make a very fine show of Pyrometers, Hallam's Ejectors, Oil Testers, and other useful inventions. Bailey's Patent Pyrometer is used for indicating heat, saving coal, and promoting uniformity of production in malt-kilns, ovens, and in other places where a certain degree of heat is requisite. The pyrometer for malt-kilns is 4 feet long, and has an enamel dial 4 inches in diameter; the dial is indicated to 300°—black figures on a white ground. One of these pyrometers has been tried at the Valley Mill, near Holyhead, and the proprietor has tested it and found it very sensitive at any change of temperature, enabling the man to keep his kiln at the proper heat, which is very important in malt-kilns. These pyrometers are also used by the Government departments for baking bread; it is also used for indicating the waste heat in flues of works and locomotives, for indicating the temperature of blast-furnaces, gas retorts, and other useful purposes where high temperatures are used.

Bailey's Oil Tester is a very ingenious instrument for finding out the value of oils as lubricants; and if good oil is used for lubricating, it reduces friction in the machinery, and thus saves coal and wear and tear. The tester may be briefly described as a piece of 3-inch shaft and two brass steps, upon which frictional pressure is obtained by weighted levers; a thermometer is fixed upon the machine, to denote the temperature. One drop of oil is put on to a drum of 3 inches diameter, friction is applied, and the "life time" of the oil (which is the technical term) is indicated by means of a speed indicator, which indicates the number of revolutions required to raise the temperature a given number of degrees. The exact money value of oil may be arrived at as follows:—Suppose a certain quantity of No. 1 oil on the machine shows 200° by being driven 10,000 revolutions, No. 2 oil shows 200° and 7500 revolutions, or 25 per cent less value. In addition to this practical way of obtaining a result, the machine may be driven to a higher tempera-

ture, to see which oil produces the worst residue. In testing various oils, a certain weight or measure must be taken; the thermometer should always indicate the same temperature at starting. It is found that 200° F. is the best to try all oils to, if their lubricating power is to be consumed, and the machine should be always driven until that temperature is indicated, and then immediately stopped; the bearings of the spindle should be well oiled, to prevent friction in the wrong place, when a temperature of 200° has been obtained (the speed index showing zero at the start), it should then be seen the number of revolutions taken to produce the temperature. After testing the oil, it is directed that the machine be stopped, and the oil is to remain on the machine, and in twelve hours after it is to be tested again to see how soon 200° can be obtained; the second experiment will indicate which oil is the inferior on machinery when stopped. The following is a short table of results on trying these various kinds of oil:—

Quality of Oil.	Temperature produced.	Total indicated Speed of Three Tests.	Market Price per gallon.	Real value of the Oils, taking No. 1 as a standard.
			s. d.	s. d.
No. 1	.. 200	120,000	6 0	6 0
No. 2	.. 200	180,000	4 0	9 0
No. 3	.. 200	60,000	2 6	3 0

It will be seen that No. 2 oil will allow 50 per cent more revolutions to be performed than No. 1, and must therefore be worth 50 per cent more money.

Messrs. Johnson and Hobbs, of Manchester, exhibit a model of a Patent Apparatus for the Condensation of Smoke, Gases, &c. This apparatus is exceedingly simple and inexpensive in its construction; it is on the paddle-wheel principle, with an addition of projections on the blades to produce a finely-divided spray of water, which falls through a series of network composed of laths, brushwood, shingle, or other material, and is so arranged as may seem best for arresting the substances to be operated upon. The same liquid may be used over and over again, until charged to any extent that may be desired. The inventors declare that this machine will be found more effective than the expensive condensing towers now used for the purpose, as it produces a powerful draught, which can be regulated at will, and the solution can be made in the machine as concentrated as may be required. The machine has been tried in condensing ammonia, and has been found to succeed thoroughly; the working parts of the apparatus can be arranged to resist the action of hydrochloric and other powerful gases affecting metal work.

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 5, 1874.

Dr. ODLING, F.R.S., President, in the Chair.

THE minutes of the preceding meeting were read and confirmed, after which Messrs. F. M. Rimington, J. Reddross, and R. H. Davies were formally admitted Fellows of the Society.

The names read for the first time were those of Messrs. George Chaloner, Thomas Charles, M.D., Henry Leicester Greville, A. S. Napier, B.Sc., Saranoske M. Nishigaiva, John Linford, James T. Armstrong, Harry Edgecumbe Thomas, and F. V. L. Cruse.

For the third time—Messrs. Howard Barrett, Thomas Pemberton Wiltshire, George Whewell, and John Young, who were ballotted for and duly elected.

The first communication was a "Preliminary Notice on the Action of Benzyl Chloride on the Camphor of the

Lauraceæ (Laurus camphora)," by DONATO TOMMASI. When camphor is heated with benzyl chloride and zinc, a violent action takes place, accompanied by the evolution of much hydrochloric acid. The distillate, after the removal of the hydrochloric acid and water, is re-distilled, by which means it is separated into two portions—a more volatile one, which passes over, and a viscous residue, containing a crystalline substance whose nature is at present undetermined. Six liquids, boiling at various temperatures from 108° to 204°, were obtained from the volatile portion by careful fractionation, the first of which, boiling at 108° to 112° C., appears to be toluol. It is probably produced by the action of nascent hydrogen on the benzylic chloride, thus— $C_7H_7Cl + H_2 = C_7H_8 + ClH$.

The PRESIDENT having thanked the author in the name of the Society, Dr. C. R. A. WRIGHT read a communication entitled "*Isomeric Terpenes and their Derivatives (Part III., On the Essential Oils of Wormwood and Citronelle).*" This paper consists chiefly of a detailed account of the author's experiments on these compounds, which had been previously communicated to the Society in a preliminary notice. The oil of wormwood, besides absinthol, yields a blue liquid of high boiling-point, Gladstone's cerulene, and also a small quantity of a terpene boiling at about 150°. The purified absinthol, $C_{10}H_{16}O$, boils at 200° to 201° (corrected). In the oil of citronelle he found a body, $C_{10}H_{18}O$, easily alterable by heat, boiling at about 210° to 225°, whilst Gladstone stated the main constituent to be a body boiling pretty constantly at 199° to 205° C., and having a formula $C_{10}H_{16}O$, so that it is probable the composition of the oil of citronelle varies with the season, age of the plant, &c. Treated with zinc chloride, absinthol yields cymene, whilst citronellol appears to give a mixture of hydrocarbons, the principal of which contains much more hydrogen than cymene. Phosphorus pentasulphide and absinthol, as previously noticed, yield cymene and thio-cymene, $C_{10}H_{14}S$, the latter forming with silver nitrate (not in excess) a yellow salt, sparingly soluble in alcohol, $C_{10}H_{13}AgS$. Citronellol, with the same reagent, yields a mixture of hydrocarbons, amongst which is one having the composition $C_{10}H_{16}$. The action of phosphorus pentachloride on citronellol causes an evolution of hydrochloric acid, and the formation of a chlorinated organic substance, which breaks up on heating, leaving a mixture of terpenes and resinous polymerides thereof. Citronellol, as already noticed, unites with bromine, and the product, $C_{10}H_{18}Br_2O$, splits up when heated, with formation of cymene, thus—



The cymenes obtained in these various reactions, when oxidised with chromic liquor, yield nothing but terephthalic acid, acetic acid, and carbonic dioxide, showing that they are identical.

Dr. ODLING said he had listened to the paper with great interest. Although we imagined that we were able to explain so many cases of isomerism, it appeared there were instances, as in the compounds of hydrogen and cymene, which were but imperfectly understood.

The author replied that it was difficult to explain the existence of four isomeric dihydrides of cymene on the ordinary supposition that the latter was a benzene derivative having the side chains opposite to one another—that is, in the 1:4 position. From thermo-chemical considerations, however, if the terpene could be regenerated by the combination of hydrogen and cymene, we should doubtless find that the different isomerides during their formation would develop different amounts of heat. The four isomerides which had been examined—namely, terebene, the hydrocarbon from oil of lemons, the terpene from oil of nutmegs, and that from oil of orange-peel—differed both in their boiling-points and in their oxidation-products. With bromine and with sulphuric acid, they all gave rise to like products, but different amounts of heat were developed during the reaction.

The next paper was a "Preliminary Notice on the Perbromates," by M. M. PATTISON MUIR, F.R.S.E. The

author forms the perbromic acid by the action of bromine on an aqueous solution of perchloric acid. On neutralising with potassium hydrate, potassium perbromate is obtained in a crystalline state, being difficultly soluble in cold water. It is isomorphous with the perchlorate and periodate. A crystalline barium perbromate is obtained on mixing aqueous solutions of barium chloride and the potassium salt, and adding alcohol; copper perbromate forms a pale green powder.

The PRESIDENT having thanked the author in the name of the Society, the SECRETARY proceeded to read a paper "*On the Coals from Cape Breton, their Cokes and Ashes, with some Comparative Analyses*," by HENRY HOW, D.C.L. This paper contains the results of the examination of the Main Seam Coal at Sydney Mine, Nova Scotia, and of the Lingan coal-mine, giving the amount of cokes produced by fast and slow coking. The author states that there are not many published quantitative analyses of coal ashes, although general enumerations of some of their constituents are by no means uncommon, and, after criticising the various published analyses, gives those made by himself of the ash of the Sydney main coal and of the Lingan coal, comparing them with those of "Bog-head."

Dr. ODLING said the results were not new, especially the varying amount of coke yielded by the coal in experiments on small quantities. The proportion of any constituent of the ash—as, for instance, the lime in a true coal yielding only 1 or 2 per cent of ash—could scarcely be compared with that of a substance, like the torbane mineral, containing as much as 30 per cent of inorganic matter.

The meeting was then adjourned until Thursday, February 19, when there will be a lecture "On the Detection and Estimation of Adulteration in Food and Drinks," by Mr. J. Bell, F.C.S. Lectures are also announced for March 19, "On Dissociation," by Mr. J. Dewar, F.R.S.E., and for May 21 on "The Sewage Question from a Chemical Point of View," by Dr. W. H. Corfield, F.C.S.

CORRESPONDENCE.

FILTERING APPARATUS.

To the Editor of the Chemical News.

SIR,—Permit me a word of explanation on the reference contained in the letter of Mr. J. F. Kerr (vol. xxix., p. 71), to the filtering apparatus proposed by me in vol. xxvii., p. 261. I merely wish to correct a mistake which I did not write to correct at the time, thinking that the error was too gross to mislead any reader.

The weight of the ash of the carded cotton-wool used for the filter was given by me as less than $\frac{1}{100}$ th grain; it was misprinted as less than 100 grains. I supposed it would be evident at once that no operator could be satisfied with a residuum which is greater than the total quantity usually operated upon of the substance to be analysed.

I would not say a word in depreciation of the beautiful apparatus of Dr. Carmichael when used for very exact analysis; but for technical purposes the manipulation is too tedious, and few flat-bottomed thin-glass beakers can bear a pressure anything like approaching to a perfect vacuum. The flask of 200 or 300 c.c. does bear a complete vacuum without danger of fracture; and the rarefaction arising from the condensation of steam gives the advantage over Mr. Kerr's method derivable from a pressure of, say, equal to 25 feet of water, instead of the 30 inches which his syphon offers.

The inversion of the flask is no source of inconvenience, and, in fact, the weight of the flask reared against an angle makes it much more easily adjustable to the lowest point of the substance to be filtered than if it stood on its own

foundation and had to be lowered, or the other vessel raised, to meet one another. The flask has this advantage over Dr. Carmichael's method, that the filtration can be effected in the vessel in which the precipitate which is left can be immediately dried and ignited.—I am, &c.,

ISAAC B. COOKE.

19 and 43, Brown's Buildings, Liverpool,
Feb. 7, 1874.

EVOLUTION AS APPLIED TO THE CHEMICAL ELEMENTS.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS for January 23rd (p. 43), Mr. W. H. Wood took upon himself the criticism of my article in *Nature*, Nov. 6th last, in default, as he says, of more experienced chemists. But, as this question is as much one of physics as of chemistry, perhaps it would have been better if he had left the matter in the hands of MM. Berthelot and Dumas, who have been lately discussing it, instead of committing himself by supposing that the melting-point of arsenic or any other body is independent of the pressure.

The fact is that the melting-points of As, Sb, and Bi, cannot well be compared together, as it is only under pressure that As will melt. But if we look at the temperature at which these bodies pass into vapour, As is found to volatilise readily at 180° (Miller); whilst, according to Watts's Dictionary, Sb melts at 430°, and volatilises at a red heat; Bi requires a still higher temperature to volatilise it, but melting as low as 260°. So these elements are not quite so anomalous as Mr. Wood tries to make out. But as to the chemistry of the question, I must own that Mr. Wood, where he finds fault with me, is in the right. I have to thank him for pointing out that, by an oversight, atomic heat was written for specific heat. If Mr. Wood wishes to hear the discussions that have lately been raised on this point, in *Comptes Rendus*, vol. 77, No. 23, he will find there a letter from Mr. N. Lockyer, read before the Academy, where, on the ground of the existence of hydrogen in the hottest of the stars, and, on the other hand, the late appearance of the metalloids in the history of the universe, he advocates what he terms the plasticity of the metalloids. The conclusion that he here arrives at, first brought before the Royal Society, is supported by Dumas, but opposed by Berthelot on the ground chiefly of the specific heat of the elements. He shows that the specific heat of the elements follows different laws from that of compounds, particularly instancing the hydrocarbons.—I am, &c.,

C. T. BLANSHARD.

Queen's College, Oxford.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, December 22, 1873.

Action of Incandescent Substances in the Transmission of Electricity.—M. Doulot.—Carbon and platinum act oppositely. Thus, a cylinder of glowing charcoal being substituted for the ball of an electroscope, if one bring near a positively charged body, the leaves will quickly diverge till they are discharged by the metallic balls on either side; then diverge again, and be again discharged; and so on, as long as the electrified body is held near. If it be removed before the leaves reach the

balls, they remain apart, with positive electricity; thus the carbon has allowed the negative electricity to flow off. The results are different where a negatively electrified body is used. The electroscope is affected only at a very small distance; the leaves separate less quickly, and they come together promptly, whenever the source of electricity is withdrawn. These phenomena are quite opposite to those observed by M. Erman with the uphlogistic lamp—that is, with an incandescent platinum wire,—which indicate that incandescent platinum allows positive electricity to flow away more readily than negative.

Muddy Eruption of Nisyros.—Letter from M. Gorceix.

Limit of Ice in the Arctic Ocean.—M. Ch. Grad.—As meteorological conditions change from year to year, the state and extension of ice vary also. But every year, and even during winter, spaces of open water and navigable passages appear throughout the whole mass. The practical inference is the importance of steam vessels, instead of sledges, in scientific expeditions to the pole.

Physical Constitution of the Sun.—(Reply to the criticisms of M. Faye).—M. Vicaire.—After answering M. Faye's objections to his method, the author takes up some of the general objections made to the results. The first is incompatibility of his (M. Vicaire's) theory with the nebular hypothesis of La Place. He indicates the principle by which he hopes to connect his views with those generally admitted as to the origin of the solar system. Originally, an extreme temperature kept the elements of the solar nebula in the state of dissociated gases. As cooling went on combinations may have commenced to form; at the same time pressure increased to the centre, since the approximation of parts increased the intensity of gravity. At a given moment a condensation may have occurred, either from a stable combination having been produced or from pressure. The nucleus thus formed at the temperature of the nebula, having a much greater radiating power, must have cooled quickly, and so strongly accelerated the condensation. That metals, or bodies like hydrocarbons, should be the first condensed, while oxygen remained in the gaseous envelope, is only natural. Later, a time came when the inverse phenomenon commenced,—that is, the combustion of the central nucleus; this was the stellar period. Before this series of phenomena the mass doubtless formed an irregular or unstable nebula, the incoherent elements of which, precipitated against each other, developed intense heat. It was then that it passed to the state of a round or elliptical nebula, with condensation increasing to the centre; then to the state of a nebulous star; and, lastly, a star. This theory simply conforms to the laws of Physics, and it agrees with the facts revealed to us by the starry heavens. The contraction, *en bloc*, supposed by M. Faye, excludes all these analogies. It is, besides, impossible that this contraction, as he thinks, was accompanied with heating. The author's theory, he holds further, agrees with Dr. Blandet's geological considerations; and it appears that the stellar period of the sun must have commenced towards the end of the geological history of our globe. Again, the central nucleus must have taken a more rapid rotation than that of the envelope, the matters collected retaining, in part at least, their initial velocity. If this state of things still subsists, spite of friction, it is because the eruptive phenomena, spots, and protuberances, by the force of impulsion they produce, and which is manifested to us by an increase of velocity towards the equator, compensate that retardative action. Some minor points (the zodiacal light, the tail of comets, &c.) are also noticed, and the question as to the duration of the sun in his stellar phase M. Vicaire reserves for a separate paper.

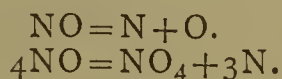
Process for Measuring the Relative Intensity of the Constituent Elements of Different Luminous Sources.

—M. Trannin.—This process is independent of the direct judgment of the eye. The apparatus consists, first, of two rectangular prisms with total reflection, superposed

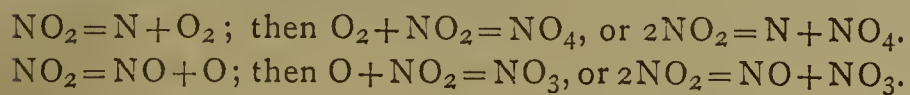
and turned in inverse direction, so as to send in the same direction, and one above the other, the luminous bundles from two sources placed on either side, in a line which is perpendicular to the common axis of the double bundle reflected by the hypotenuse faces. These prisms are placed before a narrow slit, which is thus divided into two parts, in general differently illuminated. Behind the slit is a collimator making the rays parallel. They then traverse, successively, a polariser with its principal section vertical; a quartz plate, about 1 centimetre thick, parallel to the axis, and the principal section of which makes an angle of 45° with that of the polariser; and a Rochon or Wollaston prism, having its principal section parallel to that of the polariser, and thus vertical. The dispersive prism and the telescope of a spectroscope finally receive the rays. Now each of the elementary bundles issuing from the quartz plate is polarised elliptically; and this kind of light, after passing through any bi-refrangent analyser, gives two bundles with unequal intensities polarised at a right angle, but the sum of which is constant and equal to the sum of the squares of the velocities parallel to the two axes of the ellipse. The bundle, after traversing the Rochon prism, then gives in the spectroscope a spectrum of several horizontal bands; that in the middle is due to the superposition of the ordinary bundle from one part of the slit, with the extraordinary from the other; and it will therefore be, for the eye, as if completely depolarised if these two portions are equally illuminated. Above and below this middle part will be seen two cannellated spectra, the dark fringes of the one alternating with those of the other, and between the two the luminous band referred to. If this equality do not exist for a determinate part of the spectrum, the fringes will appear anew in this part, and they may be made to disappear by diminishing the intensity of the predominant bundle, by withdrawing the luminous source, or interposing a Nicol between eye and ocular.

Researches on the Oxygen Compounds of Nitrogen; their Stability and their Reciprocal Transformations.—M. Berthelot.—Hyponitric acid is rightly regarded as the most stable of the oxides of nitrogen. If heated to 500° in a sealed tube for an hour it gives not the least sign of decomposition. It does not react either upon oxygen in the cold or upon free nitrogen at a dark red heat and in the same conditions. A series of electric sparks reduces it in a sealed tube, filled at the temperature of 30° and at ordinary atmospheric pressure, reducing it to its elements $\text{NO}_4 = \text{N} + \text{O}_4$. The decomposition stops at a certain term, as in every case where the spark develops an inverse action. After 18 hours electric action the mixture consisted of—N, 28 vols.; O, 56; and NO_4 , 14. On acting with the spark upon atmospheric air 7.5 per cent was converted into hyponitric acid in an hour; 18 hours of electrification did not sensibly modify this proportion. **Nitrous Acid** (NO_3).—Few reactions have been more studied than that of nitric oxide with oxygen, in presence of water. It was found that the proportions of the gases absorbed might vary from 3:4 to 3:12. Nevertheless the effective reaction passes always through a definite first term, nitrous acid. Gay-Lussac observed that oxygen and nitrogen, mixed in the ratio of 1:4 in presence of a concentrated solution of potassa, yielded merely a nitrite. The author finds that it is the same whatever may be the relative proportions of the gases, and the order of the mixture, in presence of concentrated solutions of alkalis, and even of baryta water, provided that the nitrous vapour which appears for a moment in the mixture is immediately removed by means of agitation in tubes sufficiently large. Analysis shows that the proportion of nitrous acid formed answers to 96 or 98 per cent of the nitric oxide employed. If the reaction goes on without the absorption of the nitrous acid as it is produced, hyponitric acid soon appears, and analysis shows then, if oxygen is deficient, a mixture of the three gases, NO_2 , NO_3 , NO_4 , whatever may be the relative excess of the nitric oxide. That is to say, that

nitrous acid only subsists for some time in the gaseous form except in presence of its products of decomposition. This complex and variable mixture constitutes the so-called nitrous vapour whenever oxygen is not in excess. The same remark applies to the liquid acid; the purest nitrous acid obtained contains about one-eighth of hyponitric acid. If oxygen is present in excess hyponitric acid alone is formed, or at least remains existent. Nitrous acid being the initial product of the reaction, we are forced to admit that it unites afterwards with a second equivalent of oxygen in a dry gaseous mixture, as well as in presence of water. The second reaction offers the remarkable character of a true gaseous combination effected with expansion; 3 vols. of the constituent gases yielding 4 vols. Nitrous oxide, if exposed to a heat of 520° for half an hour in a sealed glass tube, is decomposed into nitrogen and oxygen to the extent of 1.5 per cent, without formation of any higher oxide. The sudden compression of nitrous oxide, under circumstances capable of effecting the detonation of a mixture of hydrogen and oxygen, determines mere traces of decomposition. Nitrous oxide, mixed with oxygen and heated to low redness in a sealed tube, yields neither binoxide of nitrogen (nitric oxide) nor nitrous vapour. Nitrous oxide further exerts no oxidising action in the cold on any known body, and is neither absorbed nor decomposed by potassa (aqueous or alcoholic) at any temperature which can be reached in a glass tube, even with the aid of time. By the electric spark it is rapidly decomposed, nitrous vapour appearing at once. In one minute, and with weak sparks (produced by a Ruhmkorff's apparatus acted on by two Bunsen elements), a third of the gas was decomposed. The decomposed portion was divided in nearly equal proportions between the two following reactions:—



The first action may be regarded as due to the heat of the spark, whilst in the second heat and electricity concur. In three minutes, with stronger sparks (six Bunsen elements), three-fourths of the gas were decomposed in the same manner; the second reaction being rather in the upper hand. Nitric oxide does not appear in the electro-decomposition of nitrous oxide. The proportion of hyponitric acid formed represents about one-seventh of the final volume. The binoxide of nitrogen (nitric oxide) enclosed in a sealed tube, and heated to 520° , experiences decomposition. In half an hour a quarter of the original volume is resolved into its elements, according to the two following decompositions:—



The formation of nitrous oxide predominates. Another experiment prolonged for six hours had nearly identical results. This tends to show that the decomposition of a body by heat may stop at certain limits in presence of the bodies formed. By the action of the electric spark, one-sixth of the gas is destroyed in a minute. One-third of the product formed was nitrous oxide, the rest being nitrogen and hyponitric acids. In five minutes three-fourths of the nitric oxide were destroyed, with formation of nitrous oxide, and of nitrous and hyponitric acids. Nitric oxide is less stable in ordinary conditions than nitrous oxide. Why, then, do sulphur and phosphorus continue to burn more easily in the protoxide than in the binoxide of nitrogen—a circumstance which has caused the latter to be regarded as the more stable? The explanation may be that the binoxide does not contain in equal volumes more oxygen than the protoxide, and, on the other hand, this oxygen does not become totally available for combustion except at a very high temperature; the binoxide being at first transformed to a great extent into hyponitric acid, a body more stable than nitrous oxide. The author announces a further continuation of this subject.

Reimann's Farber Zeitung, No. 44, 1873.

This number contains an article on dyeing artificial hair for blonde pads and chignons. If dyed with fustic and alum, with the addition of annatto and pansy-lake, it appears by artificial light too "carrotty." The desired shade is best produced by logwood and an iron mordant, with the addition of cudbear, fustic, and tartar.

There are several receipts for dyeing wool and woollen piece goods, from which we select the following:—

Nicholson Blue on Cloth.—To 100 lbs. of material take 1 lb. colour of the shade required, dissolve in boiling water, filter, and make up a dye-bath with the addition of $\frac{1}{2}$ lb. sulphate of zinc. In this the goods are worked for an hour, whilst the liquid is gradually raised to a boil. They are then rinsed in cold water, and raised in a bath of warm water at 70° R., containing 2 lbs. sulphuric acid and $\frac{1}{2}$ lb. sulphate of zinc. The dye resists acids and soap.

Nicholson Blue with a Wood Bottom.—100 lbs. of woollen cloth are boiled for an hour with 1 lb. chromate of potash and 1 lb. sulphuric acid, and allowed to cool in the liquid, lifted, rinsed, and dried in a fresh bath with 30 lbs. of camwood. 2 lbs. of Nicholson blue are now dissolved in boiling water, filtered and made up into a dye-bath with the addition of $1\frac{1}{2}$ lbs. of sulphate of zinc. In this bath the goods are boiled for two hours, lifted, rinsed, and raised in a bath containing 8 lbs. sulphuric acid, and 2 lbs. of sulphate of zinc.

The next following receipt for magenta on woollen yarn contains nothing remarkable.

Aniline Violet on Woollen Yarn.—1 lb. of sulphate of magnesia is added to the lot at a hand heat; the goods (10 lbs.) are moistened therein, and methyl violet is gradually added, while the temperature is quickly brought to a boil.

Dove Colour.—Dye as for violet, using only $\frac{1}{4}$ to $\frac{1}{2}$ oz. of colour.

There are also receipts for a logwood blue on woollen yarn, a light drap on wool, a dark drap, and a madder red, topped with cochineal, on wool and woollen yarn. We insert the last mentioned. 100 lbs. of the goods are boiled for an hour with 3 lbs. alum, 6 lbs. tin crystals, 5 lbs. tartar, and $\frac{1}{4}$ lb. flavin. They are then lifted and boiled for an hour in a fresh bath with 15 lbs. madder. Meantime 4 lbs. of ground cochineal, $1\frac{1}{4}$ lbs. of tin crystals, and 1 lb. oxalic acid are boiled up, cooled, the wool entered, and boiled for an hour.

There are also receipts for a verdigris green and a magenta ponceau on cotton yarn.

In the preparation of anthracen from coal-tar, constant agitation is recommended during distillation.

Armand Müller prepares an oil mordant for Turkey-reds with an emulsion of olive oil and a solution of glue. Into this solution hyposulphite of soda is introduced, the frothing mass is allowed to stand two or three hours, and immediately used.

No. 45, 1873.

This number contains a continuation of the article on finishing silks, and receipts for a yellowish mode on wool, for a sulphate of copper black and a reddish grey on cotton-yarn, for a blue-green, a medium green, a yellow-green, a bright yellow, and a full yellow on woollen yarn.

No. 46, 1873.

This number contains a continuation of the article on finishing silks; a paper on washing and curling ostrich feathers; receipts for medium and dark Havanna, yellowish grey, and dark silver-grey on plush; aniline-blue on silk (the kind of aniline-blue not being stated); and for six shades of bluish modes on wool.

Cultivation of Madder.—The Agricultural Society of Vaucluse having made enquiries as to the future prospects of the madder grower with reference to the introduction of artificial alizarin, the Industrial Society of Mulhouse gave

the following reply:—"Artificial alizarin can never be suppressed, but along with it so much madder will always be used that its cultivation far from diminishing must increase. *As artificial purpurin is not yet known*, the extracts of natural madder must be used for the production of a yellowish red in order to have at command all the madder colours." (The passage we have italicised cannot be allowed to pass without comment. The artificial purpurin of Messrs. Perkin and Sons cannot surely have escaped the notice of the Mulhouse Industrial Society.)

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxii., No. 13, November 27, 1873.

Artificial Sugar.—The formation of artificial alizarin suggests to the *Avenir de la Guadeloupe* the possibility of artificial sugar. What is to be the raw material is not distinctly stated.

Treatment of Cane-Juice.—The process of Boivin and Loiseau has been successfully applied in Queensland.

Improvement in Photo-Lithography.—M. Paul.—The author produces a positive image on paper covered with a layer of albumen mixed with a concentrated solution of bichromate of potash. After a sufficient insolation under the negative, the paper is covered with lithographic ink, and then immersed in cold water to dissolve the unaltered albumen.

Test for the Colouring Matter of Wines.—M. de Cherville.—Pour into a glass a small quantity of the wine under examination, and dissolve in it a morsel of potassa. If there is no deposit, and if the wine takes a greenish tint it has not been artificially coloured. If a violet deposit has been formed, the wine has been coloured with elderberries or mulberries. If the deposit is red, beet-root or peach-wood has been used; and if violet-red, logwood. If the sediment is violet-blue privet berries have been employed, and if a bright violet, litmus.

Revue Scientifique de la France et de l'Etranger, No. 24, December 13, 1873.

Congress of Italian Savants; Session at Rome.—At a meeting of the Chemical Section, under the presidency of Prof. Cannizzaro, a discussion arose on the rarity of original chemical research in Italy, and on its causes. The Section was of opinion that to awaken activity in this department it is desirable that the profession of chemistry should offer to students a career analogous to that presented by engineering or by medicine. (A similar complaint and a similar suggestion might be made in England, with the additional complaint that engineers and medical men are continually encroaching upon the sphere of the professional chemist.)

Nos. 25 and 26.

These numbers contain nothing bearing upon chemistry.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in musical instruments named the pyrophone. John Garrett Tongue, of the firm of Tongue and Birbeck, patent agents and engineers, 34, Southampton Buildings, Chancery Lane, Middlesex. (A communication from George Eugène Frédéric Kastner, member of the Committee for Inventions, Paris). March 24, 1873.—No. 1091. The pyrophone is an improved musical instrument of the description known as the chemical harmonica. It is well known that when a pure hydrogen gas jet burns in a glass or china tube, or other vibrating material, a pleasant soft tone or sound is produced. The characteristic novelty of this improved instrument consists in the construction of the burners, and in the combined apparatus employed to act on these burners by means of the touch on the keys similar to an ordinary piano, in order to obtain the sound or note required, or to stop it instantly as required. The burners are constructed with double oscillating branches in such manner that the two jets are brought into one by the contact of the two arms or branches, whilst at the moment the sound or note is produced the two branches are separated and form two distinct jets, which produce the vibration and consequent sound in the glass, china, or other tube which surrounds the branches of each jet or burner. These improvements in the construction of

the pyrophone consist—First, in dispensing with the inlet cock for the gas. Second, in the means employed for dispensing with the two cocks heretofore employed for regulating the passage of gas to the two branches of each tube. Third, in a more simple arrangement of mechanism for transmitting the movement of each key to its own two corresponding branches.

Improvements in the preparation of ozone, and in the application of the same to various useful purposes. John Henry Johnson, 47, Lincoln's Inn Fields, Middlesex. (A communication from Pierre Isidore David and Jacques Fichet, Paris). April 2, 1873.—No. 1222. This invention relates to a simple method of preparing ozone by causing atmospheric air to pass through water containing sticks of phosphorus, and to the employment of such ozone for the destruction of organic matter, the bleaching of fibrous and other substances, also paper either before or after it has been printed upon, also for giving age to alcoholic liquors, modifying the quality of oils and fatty matters, and rendering more salubrious the wards of hospitals and sick rooms.

Improvements in galvanic batteries. Lionel Weber, 104, Rue Royale, Place de Congrès, Brussels. April 5, 1873.—No. 1270. The claims to this complete specification are—First. The exclusive use and application of carburet of iron, of whatsoever denomination, quality, and production, for generating electricity in galvanic cells and batteries generally. Second. The employment of a jar of particular shape, made of glass, of porcelain, or any other appropriate substance.

Improvements in the method of and in apparatus for ascertaining the temperature of hot-blast or of heated gases, partly applicable to pyrometers otherwise used. Henry Hobson, Workington, Cumberland. April 5, 1873.—No. 1271. The inventor brings together hot- and cold-blast in known proportions, and tests this mixture with a pyrometer or thermometer for temperature. When constructing a pyrometer for the above or for ordinary uses, he employs metal wire, riband, cord, or chain wound upon pulleys to make the instrument more compact, one end of the wire being connected with the index either directly or by means of multiplying pulleys and chains or wires. Levers may be substituted for the first-named pulleys.

Improvements in the treatment of substances and liquors containing ammonia and cyanogen, and in obtaining products therefrom. Arthur William Ellis, manufacturing chemist, Madeira Villas, Woodford, Essex. April 7, 1873.—No. 1274. Freeing cyanogen (evolved in the distillation of ammoniacal liquor) from aqueous vapours before passing it into a combining agent, and also the use of an additional vessel or additional vessels in order the more completely to attract and retain the cyanogen.

NOTES AND QUERIES.

Decolourising Syrup.—Could you kindly inform me if you are aware of Mr. Beanes having done anything towards perfecting his process of decolourising syrup by means of ozone?—CHAS. CUNNINGHAM.

Coal-Tar.—Would any of your readers please state the methods of estimating the amount of benzol, solvent naphtha, burning naphtha, &c., from the results of the analysis of the crude substance, or any work on the analysis of coal-tar.—YOUNG STILLMAN.

Naphthalene.—Please inform me through your columns of the most important uses at present for naphthalene (pure or crude), also the most direct method for extracting anthracene from heavy oil or pitch, or refer me to any article on the subject that may have been published in the CHEMICAL NEWS.—MIAMI.

Sulphur Determinations.—I would feel obliged if any of your readers would state what he considers the best and quickest method of estimating sulphide, sulphite, and hyposulphite of sodium in presence of one another in sodium carbonate solution, also a ready method for the qualitative estimation of the latter two in same solution.—B. P.

MEETINGS FOR THE WEEK.

MONDAY, Feb. 16.—Medical, 8.

— London Institution, 4.

— Society of Arts, 8. Dr. Graham, "On Fermentation."

TUESDAY, 17.—Royal Institution, 3. Prof. Tyndall, "On the Physical Properties of Liquids and Gases."

— Civil Engineers, 8.

— Anthropological, 8.

— Zoological, 8.30.

— Society of Arts, 8. Mr. Trelawny Saunders, "On the Present Aspects of Africa, with reference to the Development of Civilised Trade with the Interior."

WEDNESDAY, 18.—Society of Arts, 8. Mr. G. C. T. Bartley, "On Thrift as the Outdoor Relief Test." On this evening the Right Hon. the Earl of Derby will preside.

— London Institution, 7.

THURSDAY, 19.—Royal Institution, 3. Prof. P. M. Duncan, F.R.S., "On Palæontology, with reference to Extinct Animals and the Physical Geography of their Time."

— Royal, 8.30.

— Royal Society Club, 6.

— Chemical, 8. J. Bell, F.C.S., "On the Detection and Estimation of Adulteration in Food and Drinks."

FRIDAY, 20.—Royal Institution, 8; Weekly Evening Meeting. Mr. M. Vernon Heath, "The Autotype and other Photographic Processes and Discoveries, 9.

— Geological, 1. Anniversary.

SATURDAY, 21.—Royal Institution, 3. Mr. R. Bosworth Smith, "On Mohammed and Mohammedanism."

THE CHEMICAL NEWS.

VOL. XXIX. No. 743.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 77).

PREPARATION OF COMMERCIALY-PURE THALLIUM.

(a). *From the Flue-Dust of Pyrites-Burners.*—This is by far the most economical source of thallium at present known. In burning thalliferous pyrites for the purpose of manufacturing sulphuric acid, the thallium oxidises along with the sulphur, and is driven off by the heat. If the passage leading from the burners to the leaden chambers is only a few feet long, the greater portion of the thallium escapes condensation, and is carried into the leaden chambers; it there meets with aqueous vapours, sulphurous and sulphuric acids, and becomes converted into sulphate of the protoxide of thallium. This being readily soluble both in water and dilute sulphuric acid, and not being reduced by contact with the leaden sides, remains in solution, and accompanies the sulphuric acid in its subsequent stages of concentration, &c. If, on the other hand, the passage connecting the burners and chambers is 10 or 15 (or more) feet in length, nearly the whole of the thallium is condensed, together with the multiplicity of other bodies which constitute "flue-dust." Accompanying the thallium have been found mercury, copper, lead, tin, arsenic, antimony, iron, zinc, cadmium, bismuth, lime, and selenium, together with ammonia, sulphuric, nitric, and hydrochloric acids. The amount of thallium in these flue-deposits is very various; in many specimens it is not present at all, and in very few it amounts to as much as $\frac{1}{4}$ per cent, although in some as much as 8 per cent of thallium has been found.

The following is the best plan for extracting thallium from the dust:—The dust is first heated to very dull redness, so as to allow the excess of sulphuric acid to drive off any hydrochloric acid which may be present, and is then mixed in wooden tubs with an equal weight of boiling water, and well stirred; after this the mixture is allowed to rest for twenty-four hours for the undissolved residue to deposit. The liquid is then syphoned off, and the residue is washed, and afterwards treated with a fresh quantity of boiling water. The collected liquors which have been syphoned off from the deposit are allowed to cool, precipitated by the addition of a considerable excess of strong hydrochloric acid, and the precipitate, consisting of very impure chloride of thallium, is allowed to subside. The chloride obtained in this way is then well washed on a calico filter, and afterwards squeezed dry. Three tons of flue-dust treated in this way yielded as much as 68 lbs. of this crude chloride.

The next step consists in treating the crude chloride in a platinum dish with an equal weight of strong sulphuric acid, and afterwards heating the mixture to expel the whole of the hydrochloric acid. To make sure of this, the heat must be continued until the greater part of the excess of sulphuric acid is volatilised. After this the mass of bisulphate of thallium is dissolved in about twenty times its weight of water, nearly neutralised with chalk, and then filtered. On the addition of hydrochloric acid to the filtrate, nearly pure chloride of thallium is thrown down; this is collected on a filter, well washed, and then dried. The crude protochloride of thallium obtained by either of the above methods is added by small portions at a time to half its weight of hot oil of vitriol in a porcelain or platinum dish, the mixture being constantly stirred and the heat continued till the whole of the hydrochloric acid

and the greater portion of the excess of sulphuric acid are driven off. The fused bisulphate is now to be dissolved in an excess of water, partially neutralised with carbonate of sodium, and an abundant stream of sulphuretted hydrogen passed through the solution. The precipitate, which may contain tin, arsenic, antimony, bismuth, lead, mercury, and silver, is separated by filtration, and the filtrate is boiled till all free hydrosulphuric acid is removed. The liquid is now to be rendered alkaline with ammonia, and boiled; the precipitate of iron and alumina, which generally appears in this place, is filtered off, and the clear solution evaporated to a small bulk. Sulphate of thallium will then separate out on cooling in the form of long, clear, prismatic crystals. As sulphate of ammonium is much more soluble than sulphate of thallium, the latter can readily be separated from the small quantity of the former salt present. The two salts do not crystallise together.

In order to avoid the inconvenience of driving off the excess of oil of vitriol in the decomposition of chloride of thallium, it is less troublesome, although not quite so economical, to proceed as follows:—Boil the chloride of thallium in solution of sulphide of ammonium for five minutes: decomposition takes place readily. Filter and wash with sulphuretted water till no more chlorine can be detected in the filtrate; then dissolve the sulphide on the filter in dilute sulphuric acid, and treat the solution with ammonia, &c., as above directed.

In order to obtain the metal when working on small quantities of material, sulphate of thallium is dissolved in twenty times its weight of water; the liquid is acidulated with sulphuric acid, and a current of electricity from two or three cells of Grove's batteries is passed through it, platinum terminals being used. The appearance presented when a tolerably strong solution of thallium is undergoing reduction is very beautiful. If the energy of the current bears a proper proportion to the strength and acidity of the liquid, no hydrogen is evolved at the negative electrode, but the metal grows from it in large, crystalline, fern-like branches, spreading out into brilliant metallic plates, and darting long needle-shaped crystals, sometimes upwards of an inch in length, towards the positive pole, the appearance being more beautiful than with any other metal. Some of the tabular crystals, as seen in the liquid, are beautifully sharp and well defined; considerable difficulty, however, is met with in disengaging them from the electrode, and removing them in a perfect state from the liquid. So long as thallium is present in the solution, no hydrogen is evolved with a moderate strength of current; as soon as bubbles of gas are evolved, the reduction may be considered complete. The crystalline metallic sponge may now be squeezed into a mass round the platinum terminal, disconnected from the battery, quickly removed from the acid liquid, rinsed with a jet from a wash-bottle, and transferred to a basin of pure water. The metal is then carefully removed from the platinum, and kneaded with the fingers into as solid a lump as possible. It coheres readily by pressure, and will be found to retain its metallic lustre perfectly under water.

When considerable quantities of thallium are to be reduced to the metallic state, it is convenient to employ metallic zinc for the purpose. In the course of twenty-four hours I have reduced upwards of a quarter of a hundredweight of the metal in the following way:—Plates of pure zinc (which should leave no residue whatever when dissolved in sulphuric acid) are arranged vertically round the sides of a deep porcelain dish holding a gallon. Crystallised sulphate of thallium, in quantities of about 7 lbs. at a time, is then placed in the dish, and water poured over to cover the salt. Heat is applied, and in the course of a few hours the whole of the thallium will be reduced to the state of a metallic sponge, which readily separates from the plates of zinc on slight agitation. The liquid is poured off, the zinc removed, and the spongy thallium washed several times. It is then strongly compressed between the fingers, and preserved under water until it is ready for fusion.

* A Paper read before the Royal Society June 20, 1872.

The metal is readily obtained in the coherent form by fusing the sponge. This is most conveniently performed under cyanide of potassium on the small scale, and under coal-gas when working with large quantities. In the former case, the sponge, strongly compressed and quite dry, is broken into small pieces, which are dropped one by one into cyanide of potassium kept fused in a porcelain crucible. They rapidly melt, forming a brilliant metallic button at the bottom. When cold, the cyanide of potassium may be dissolved in water, when the thallium will be left in the form of an irregular lump, owing to its remaining liquid and contracting after the cyanide has solidified. On the large scale, the fusion is best effected in an iron crucible. This is placed over a gas-burner, and a tube is arranged so that a constant stream of coal-gas may flow into the upper part of the crucible. Lumps of the compressed sponge are then introduced, one after the other as they melt, until the crucible is full of metal. It is then stirred up with an iron rod, and the thallium may either be poured into water and obtained in a granulated form, or cast into an ingot. Thirty or forty fusions have been performed in the same crucible without the iron being appreciably acted upon by the melted thallium.

(b). *From Iron Pyrites.*—The richest pyrites which I have yet met with comes from Oneux, near Theux; it contains about 1 part of thallium in 4000. Two tons of this ore were worked in the following manner:—

The pyrites, broken up into pieces of the size of a walnut, is distilled in hexagonal cast-iron pipes, closed at one end, and arranged in a reverberatory furnace. Conical sheet-iron tubes are luted on to the open ends, and the retorts are kept at a bright red heat for about four hours. At the end of the operation, the receivers are found to contain from 14 lbs. to 17 lbs. of dark green- or grey-coloured sulphur for every 100 lbs. of ore used. The whole of the thallium originally in the pyrites will be found in this sulphur, from which it has now to be separated. The sulphur may be dissolved out by means of bisulphide of carbon, which leaves the sulphide of thallium behind, or it may be extracted by boiling with caustic soda. The former plan occasions less loss of thallium, but, owing to the inconvenience of working with large bulks of bisulphide of carbon, the soda process is preferable. 12 lbs. of caustic soda, 18 lbs. of the thalliferous sulphur, and $1\frac{1}{2}$ gallons of water are boiled together till the sulphur has dissolved; 6 gallons of water are added, and the clear liquid, when cool, is decanted from a voluminous black precipitate, which has been separated from the sulphur. The precipitate is then collected on a calico filter, and washed. It contains the greater portion of the thallium in the form of sulphide, together with iron, copper, mercury, zinc, &c. Some thallium, however, remains dissolved in the alkaline liquid, and is lost. The black precipitate is then dissolved in hot dilute sulphuric acid, to which a little nitric acid is added, and the liquid is diluted with water, and filtered. Hydrochloric acid and a reducing agent, such as sulphite of sodium, will now throw down the nearly insoluble white protochloride of thallium, which is to be filtered off and washed.

(c). *From Sulphur or Pyrites in the Wet Way.*—The material is boiled in nitro-hydrochloric acid until nothing but bright yellow sulphur is left; water is then added, and the filtrate is evaporated with sulphuric acid until it is nearly dry, and sulphuric vapours are copiously evolved. The residue is dissolved in a large excess of hot water, and carbonate of sodium is added to alkaline reaction, and then cyanide of potassium (free from sulphide of potassium). The liquid is then heated gently for some time, and filtered. The precipitate contains the whole of the lead and bismuth which may be present, as carbonates, whilst the thallium is in solution. A current of sulphuretted hydrogen being now passed through the alkaline liquid precipitates all the thallium, whilst the copper, antimony, tin, and arsenic remain dissolved. The precipitated sulphide is filtered off, washed, and dissolved in dilute sulphuric acid, and the thallium is precipitated by

means of hydrochloric acid as chloride, from which the metal is extracted in the way previously described.

(d). *From the Saline Residues of the Salt-Works at Nauheim.*—Dr. Böttger adds an insufficient quantity of bichloride of platinum to the strong solution, and boils the precipitate five or six times with three times its weight of water. The insoluble residue consists of the platinum salts of caesium, rubidium, and thallium. Upon boiling these with a weak solution of potash and a little hyposulphite of sodium, the solution soon becomes clear, whereupon cyanide of potassium and sulphuretted hydrogen are added. This precipitates the thallium as sulphide. The liquid is then to be filtered, the residue washed and dissolved in sulphuric acid, and the metal precipitated by metallic zinc.

(e). *From Commercial Hydrochloric Acid.*—Many samples of yellow hydrochloric acid contain thallium. It may be separated by neutralising with an alkali and adding sulphide of ammonium. The black precipitate contains the thallium, together with iron and some other metallic impurities of the acid. It is to be dissolved in sulphuric acid, and the thallium precipitated with hydrochloric acid as protochloride. This is afterwards reduced as already described.

(f). *From the Mother-Liquors of the Sulphate-of-Zinc Works at Goslar.*—Each kilogramme of these liquors is said to yield as much as half a gramme of chloride of thallium. A sheet of zinc is plunged into the liquid, whereby the thallium, copper, and cadmium are precipitated. The metallic sponge is then removed from the zinc, washed, and treated with cold dilute sulphuric acid, which dissolves the cadmium and thallium with disengagement of hydrogen, whilst the copper is left behind. The filtrate from the copper is then mixed with hydrochloric acid, which precipitates the nearly insoluble chloride of thallium. If only a small quantity of thallium is present, iodide of potassium may be used as a precipitant, as the iodide of thallium is insoluble in water.

(To be continued).

ESTIMATION OF MANGANESE IN SPIEGELEISEN.

By JOHN PARRY.

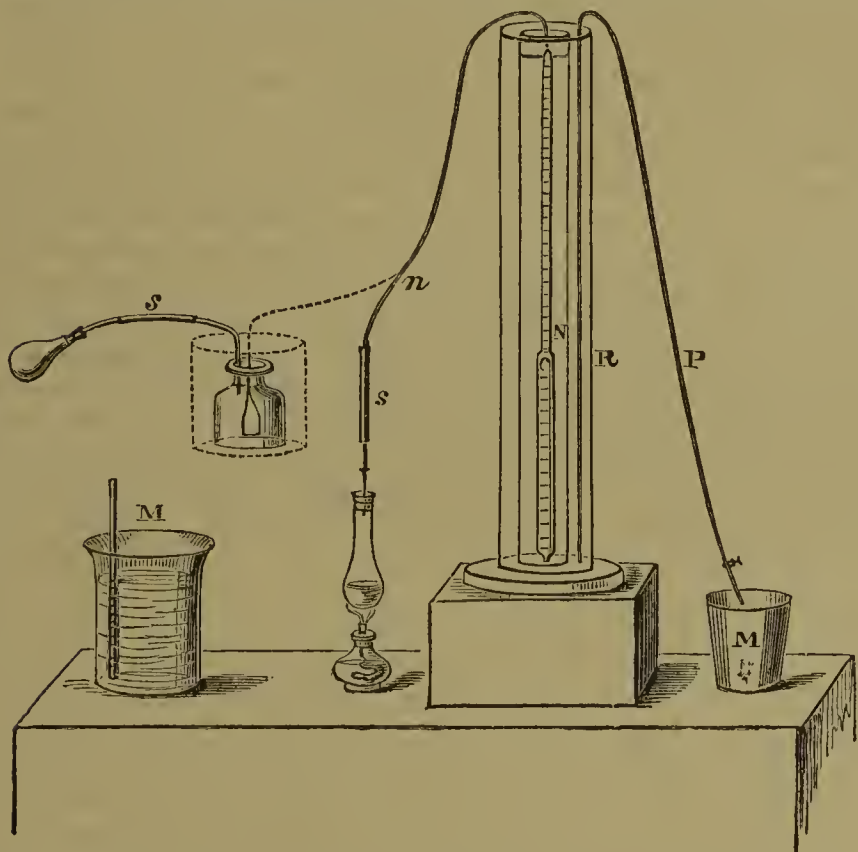
THE ordinary method of separating MnO from Fe_2O_3 is by precipitating the latter with ammonia and sodic acetate, retaining MnO in solution, to be estimated by precipitation with bromine and ammonia. Manganese may thus be very accurately estimated, yet it is difficult to ensure the perfect separation of MnO from Fe_2O_3 ; the presence of the latter in solution is easily detected, but it is well known that it is difficult to obtain the Fe_2O_3 precipitate free from traces of manganese, and it is necessary to redissolve the Fe_2O_3 precipitate, and boil afresh with sodium acetate; in most instances, a further notable quantity of manganese is found. On the whole, the process is a very slow one, requiring more time and attention than can well be spared in a busy laboratory where frequent and rapid manganese estimations are called for.

It occurred to the author that Fresenius and Will's method—in which the quantity of MnO_2 in manganese ore is determined by the amount of CO_2 evolved on treatment of the ore with sulphuric acid and sodium oxalate—might be applied to the estimation of manganese in spiegeleisen, provided the latter could be obtained in the form of a dry oxidised product containing always a definite manganese oxide, either MnO_2 or Mn_2O_3 . After many trials, the following process was found to give good results:—

0.5 grm. spiegeleisen dissolved in nitric acid (sp. gr., 1.2), and evaporated to dryness in a small pear-shaped glass flask, and, lastly, heated to redness over a small Bunsen's burner for ten minutes, the flask and its contents allowed to become quite cold, sodium oxalate and hydrochloric

acid added, and the flask, &c., quickly connected with the apparatus for collecting and measuring the CO_2 evolved;* the glass cylinder, R, and graduated tube, C, having been previously filled with mercury, by pouring mercury into R, thence rising in C, which is open at the bottom. The flask is gently heated until a clear solution is obtained; the CO_2 generated passes into the tube, C, as shown. As the gas passes into C, the top of the syphon, P, is opened, and the mercury run out into M. The mercury in C and R must be kept at about the same height, otherwise the india-rubber cork closing the flask may be blown out. When sufficiently cool, the flask is plunged into water, and allowed to remain there not less than ten minutes, until the water has attained the same temperature as that in glass cylinder, N, enclosing the gas-tube. Mercury is poured into R until the mercury in C and R stands at the same height, the number of divisions of CO_2 evolved read off noting the temperature of the water in N and M, also the height of the barometer.

The gas-tube used by the author is graduated in m.m.—the upper smaller part, about 300 m.m.=30 c.c. capacity, the wide lower part, about 150 m.m.=50 c.c. capacity. These are only approximate. Of course, each tube must



be carefully calibrated previous to use, and the value of each division determined. The number of c.c. CO_2 (B., 760; T., 0°) being known, it is easy to calculate the corresponding quantity of manganese—

87 parts by weight $\text{MnO}_2=88$, $\text{CO}_2=55$ manganese. It was, however, found impossible to obtain a product containing MnO_2 . Although many experiments were made with this object, heated over the Bunsen's burner as previously described, the manganese was always present as Mn_2O_3 , and further heating for thirty minutes showed no loss of oxygen. Consequently, 88 parts CO_2 represented 110 metallic manganese. Example—

0.5 grm. spiegeleisen gave CO_2 .. 31.80 c.c.
Temperature 19.00°
Barometer 738.00 m.m.
Tension of aqueous vapour .. 16.36 ..
 $31.8 \times 721.64 = 28.22 \text{ c.c. } \text{CO}_2 \times 0.1966 \times 110 =$
 $760 \times (1) + (0.003665 \times 19) = 88$
 $= 0.06934 \text{ grm. Mn.}$

Manganese 13.868 per cent.
The above calculations appear rather tedious, but it is evident the calculation takes less time than when manganese is estimated by precipitation, the latter process requiring at least six hours, and in most instances a much longer time. Also the calculation may be simplified by

* A small chloride of calcium tube is attached here (see sketch).

the use of the tables given in Sutton's "Volumetric Analysis," where the divisor for the formula—

$$\frac{V \times B}{760 \times (1 + \delta T)}$$

is given. Also the value of 1 c.c. of CO_2 shown by the instrument may be expressed in parts by weight of Mn. Thus, 28.22 c.c. $\text{CO}_2=0.06934$ grm. CO_2 ; therefore, 1 c.c.=0.00245716 grm. Mn, which, multiplied by x c.c. CO_2 found, gives at once the corresponding amount of manganese.

Test Experiments—

0.500 grm. spiegeleisen	gave 28.20 c.c. CO_2	= 13.860 % Mn
" " "	" 28.05 "	= 13.800 "
By weight—Manganese 13.740 %		
0.500 grm. spiegeleisen (1)	gave 23.57 c.c. CO_2	= 11.600 % Mn.
" " "	(2) " " "	" " "
" " "	(3) " " "	" " "
" " "	(4) " " "	" " "
" " "	(5) " " "	" " "
0.253 "	" 11.70 "	11.500 "
0.264 "	" 12.60 "	11.350 "
0.250 "	" 11.80 "	11.590 "
1.000 "	" 47.00 "	11.547 "
By weight 11.530 "		

By substituting water for mercury, and connecting the tube, n, with a bladder, &c., immersed in a large beaker of water, as shown by the dotted lines (see Fresenius's "Analysis," 5th ed., p. 152), results sufficiently accurate have been obtained, and the trouble and expense of the use of mercury obviated. The apparatus becomes a modification of Schiebler's, and may be used for the same purpose, also applied to the determination of CO_2 in limestone, ores, &c.

The above method of analysis only occurred to the author after a perusal of a paper written by Dr. Russell on the measurement of gases as a branch of volumetric analysis; previously attempts were made according to Bunsen's method, in which the chlorine resulting from the decomposition of MnO_2 or Mn_2O_3 by HCl is passed into iodide of potassium solution, and the liberated iodine titrated with hyposulphite of sodium; this method, however, did not give good results.

NOTE.—This method has been applied to the determination of manganese in steel, treating not less than 4 grms. steel, and measuring over mercury. The dry product requires a rather stronger heat, best accomplished by heating over a small Bunsen's burner in an open platinum capsule. It is best to take 10 grms. steel, and evaporate to dryness in a porcelain dish, and heat a weighed portion of the dry residue as above, reserving part for a second trial.

EXHIBITION OF APPLIANCES FOR THE PRODUCTION AND ECONOMICAL USE OF FUEL, IN CONNECTION WITH THE SOCIETY FOR THE PROMOTION OF SCIENTIFIC INDUSTRY, MANCHESTER.

(Continued from page 80).

CROSSLEY BROTHERS, of Manchester, exhibit an Atmospheric Gas Engine. This engine works as follows:—Gas and air, mixed in such proportions as to give a mild explosive compound, are admitted under a piston which slides air-tight in a vertical cylinder open at the top. The compound is ignited, explodes, and the explosion drives the piston upwards. The ignited gases, having increased in volume, lose their heat; their pressure becomes less as the piston rises, and when it has got to the top of the cylinder a partial vacuum is formed, and the pressure of the atmosphere makes the piston descend. The work thus done steadily by the atmosphere during the return

stroke of the piston yields the driving power, which is transferred to the shaft by suitable mechanism. This utilisation of the instantaneous power of the explosion, by allowing the piston to fly up freely from it without doing other work than emptying the cylinder of air, is the basis of the economy and success of these engines. The sudden energy of an explosion cannot be economically applied to push a piston slowly along against a load, as in the case of steam-engines; it is thus that other gas engines have been superseded by this patent. Some of the advantages of this engine, compared with steam engines, are, that it can be started at a moment's notice, and will at once give out its full power; thus no time is lost in waiting to get up steam. The attendance required is exceedingly small, averaging one hour per day for a man, including cleaning, oiling, stopping, and starting. The fuel has not to be got into the house, nor ashes to be got out; gas is said on, thus much trouble is saved. No constant supply of water is required; a quart a day suffices. Gas at 4s. per thousand feet will feed the engine at one penny an hour per horse-power. Gas can only be burnt in exact proportion to the power required; this is controlled by a governor. These engines cannot be used for high horse-power; from one to two horse-power is the most they can be used for. From the many testimonials received, it seems that the cost of gas is less than one penny per hour.

The show of fire-grates, kitchen ranges, various kinds of coal savers, is very good, and perhaps the most complete in the Exhibition. The grates, &c., are all in use in the third annexé of the building, so that spectators can judge for themselves as to the relative merits of the various inventions. What would have made this show still more interesting would have been to have given the weight of coal consumed by each fire during the day to produce the desired effect; as it is, one sees an interesting collection of machines for saving fuel, but no experiments seem to have been performed by competent judges to test the truth of each inventor's statements. There are various grates for utilising the waste heat of the fire and causing it to warm air chambers, which warm air is carried to different rooms in the house.

Shillito and Shorland exhibit patent grates and hot-air boxes for extracting waste heat from every description of grates and kitchen ranges, thereby effecting a saving of at least 50 per cent in fuel, without at all interfering with the general appearance of grates. One of their 30s. boxes can be inserted behind register or sham register stoves now in use, and could also be placed behind a kitchen fire without taking down the range or grate, and, according to the inventor's statement, will raise temperature in excess of external atmosphere from 10° to 20°, and discharge into room or lobby 2000 cubic feet of warm air per hour. The advantages of this fire-box grate over the ordinary grate are, that it secures a supply of perfectly fresh, warm, pure air, and diffuses it equally over the whole room, or rooms requiring to be heated, the cold air admitted from the outside being perfectly fresh, and warmed by passing over the inside back of the grate. The objection to other hot-air stoves, that they draw their supply from the already vitiated air of the room, is obviated. When this grate is used in dwelling-houses two rooms can be heated by the same fire—the open fire serving for one room, and the heated fresh air being thrown into the next.

Thomas Whitwell exhibits a grate on a similar principle. By his fire-place he injects warm air into the room at a temperature between 65° and 115° F.

Rogerson and Co. show Corbitt's Improved Economic Warming and Ventilating Grate. It is simple in construction. The best points of the modern grate are preserved, viz.:—The cheerful open fire; large reflecting and radiating surface; reduced size of fire-box, with convex back, which is composed of fire-brick, and, being a bad conductor, throws the heat into the room; the draught-flue, opening into the chimney, is regulated by Louvre

valves, so that no waste heat need pass up the chimney beyond the products of combustion.

The most successful and ingenious fire-grate in the Exhibition is the invention of the Rev. J. Wolstencroft, and is called the Vacuum Draught. The inventor says the great difficulty is solved, viz., "how to get a healthy, cheerful fire, imparting a genial heat, with half the amount of fuel commonly used." We saw the grate in use, and we must candidly admit it was the most cheerful and the brightest fire in the place, but as to the amount of coal it daily consumed we are unable to say. According to some experiments which have been performed with it by James D. Curtis, Commander Royal Navy, there is truth in the inventor's statement, that there is a great economy in the consumption of fuel. Captain Curtis, of Brimpsfield, Gloucester, experimented with the grate in his harness-room from the 18th of August, 1873, to the 1st of September, 1873, using no other fire, burning slack coal delivered for 24s. per ton, employing this fire daily for cooking small things, such as boiling potatoes for the fowls, &c., and after the daily use the fire was left to burn itself out during the night; the cost of coal per day was 3½d. The front of the grate is continued down to the floor, cutting off the supply of air from within the room; by this means an air chamber is formed under the grate, to which the air is communicated from within or without the building, bringing the draught under and directly through the fire-bars. In a fire-grate which has been fitted up in Manchester, at the office of one of the Local Boards, the air-chamber communicates with the main sewer, and draws its supply from thence, thus, as it is supposed, ventilating the sewer, at the same time consuming the noxious sewer gases. Any kind of fuel can be used, and very small coal can be burnt as easily and with as good results as lumps; coke and cinders may be burnt over and over again, until they become as fine as sand. The ashes from the fire all drop through the bottom of the grate into or through the air chamber, consequently dust from the fire is greatly diminished in the room; the draught may be regulated at pleasure with a valve. The invention may be easily applied to many existing grates at the cost of a few shillings.

By the side of Wolstencroft's fire-place was Kenyon's Patent Coal Saver, which consists of a perforated fire-brick tile, to put into the grate and fill up the coal space, throwing the hot coals to the front of the fire-place, while the back of the fire is comparatively cold. It has the disadvantage of presenting a very dull fire while it is carrying out its principle of saving coal, presenting a great contrast to Wolstencroft's; indeed one might almost think it was placed there as a foil for his more successful competitor.

Crawshaw's Household Coal Saver is a corrugated piece of iron or clay placed behind an ordinary coal-fire. It radiates the heat from the fire into the room, instead of allowing so much waste heat to pass up the chimney.

Frisbie's Patent Feeder and Grate is a most ingenious arrangement for feeding a fire with coal from the bottom. This feeder and grate provides a simple method of feeding fuel up, from underneath the fire, into all descriptions of furnaces, fuel-boxes, and fire-grates. By this principle of feeding from below the fire there is no fresh consumption of the fuel, the igniting of the fresh coal is a gradual process, while at the same time a very intense heat is obtained. The hottest portion of the fire being constantly at the top utilises the heat, and preserves the fire-bars from being burnt out; the heat of the surface of the fire is not abated by the supply of fresh fuel, and no cold air is admitted to the furnace while feeding, thereby preserving a perfectly uniform heat. By feeding from beneath, the coal is pushed up and outwards equally from the centre of the grate, and is evenly consumed, with scarcely any refuse except fine ashes, which drop down through the grate-bars without raking. From various testimonials which the inventor has received, it seems that there is a great saving in the use of the

coal; thus one firm says their coal bill averaged £160 a month, but on introducing one of these burners they only used that quantity in four months.

Folloms and Bate, of Manchester, exhibit a large collection of stoves and fire-grates. One of their novelties is a Portable Water-Boiler, which consists of an upper and lower chamber, and is so constructed that the upper chamber is filled with cold water, and as the hot water is drawn off from the lower, the cold water is allowed to fall down through a small pipe, so that there is a constant supply of warm water. It will boil 11 gallons in 20 minutes, or three or four hundred persons can be supplied with hot water for tea at a cost of 3 lbs. of coal.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 13th, 1874.

E. W. BINNEY, F.R.S., F.G.S., Vice-President, in the Chair.

MR. ROOKE PENNINGTON, of Bolton, was elected an ordinary Member of the Society.

A drawing was shown representing some further improvements of Dr. Joule's mercurial air exhauster, described in the *Proceedings* of February, 1873.

In the section represented by Fig. 1, *W W* is a wooden frame; *P* a pulley for raising or lowering a flask of mercury held in a wooden box, *M*, working in a slide; *s, s, s, s* are india-rubber stoppers; *E* is the exhauster; *t, e*, the entrance and exit tubes; *g* the gauge; *f* a funnel to admit sulphuric acid; *B, B*, movable brackets to support any apparatus.

In Fig. 2 the exhauster is drawn to a larger scale. *t, e* are the entrance and exit tubes, fitting tightly in an india-rubber disc, *a*, which disc is kept tightly pressed against the exhauster by means of the ring, *b, b*. The mercury is represented sunk below the entrance tube, as is the case when the movable flask is in its lower position. On raising the flask by means of the pulley, the mercury rises in the exhauster and forces any air it may contain into the upper part of the exhauster by raising the india-rubber plug. The air then makes its exit through the pipe *e*. This latter is also used for withdrawing the acid which gradually accumulates.

Fig. 3, also drawn to a large scale, represents a convenient means of introducing sulphuric acid for removing aqueous vapour, or to let air into the apparatus. The orifice at the bottom of the funnel is about 1-100th of an inch diameter, to prevent violent action.

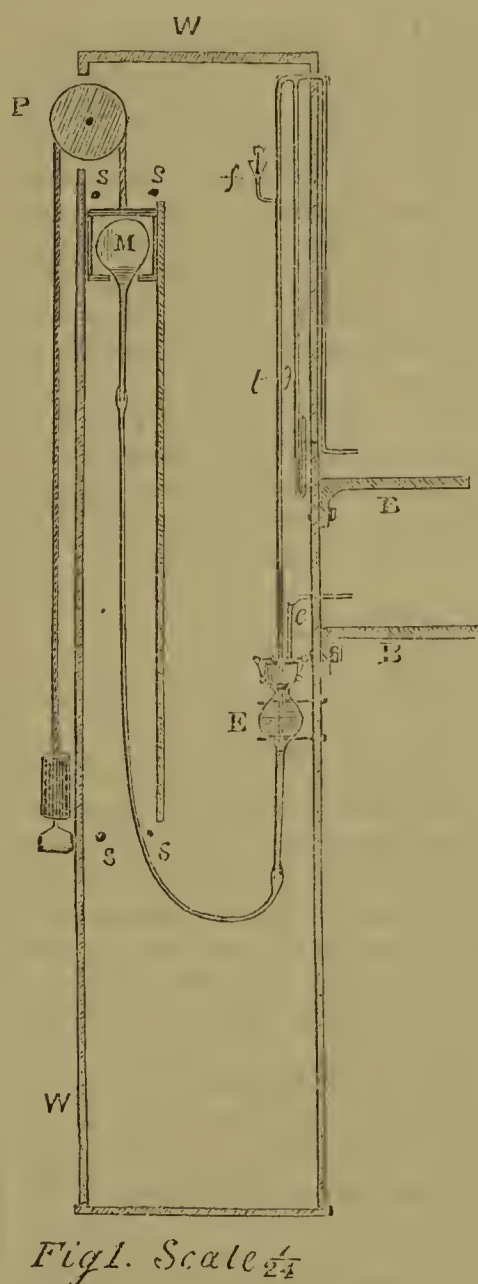
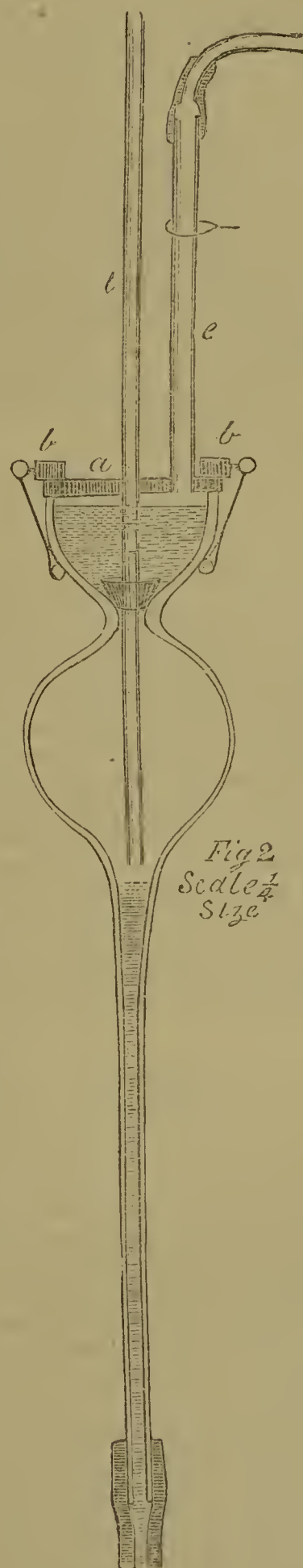
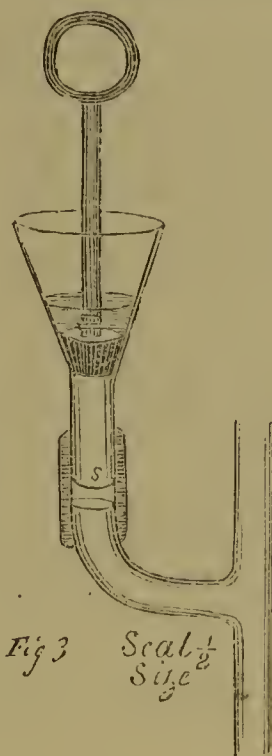
It may be useful to mention that the junctions are made with black india-rubber tube fastened by softened iron wire.

"On the Influence of Acids on Iron and Steel," by WILLIAM H. JOHNSON, B.Sc.

In a paper published in the *Proceedings* of the Society for March 4th, 1873, I mentioned that if a piece of steel wire be immersed in hydrochloric or sulphuric acid for ten minutes or more, and then well washed with water and dried, that on breaking it bubbles were not seen to rise through the moisture on the surface of the fracture as was the case with iron wire. Subsequent experiments made under the microscope with a power of 250 diameters, however, show that very small bubbles are given off with great rapidity, sometimes from the whole, sometimes from part only, of the fractured surface.

This difference in the behaviour of iron and steel is most likely connected with the difference of molecular

structure. Thus the fracture of a steel wire containing, say, 0.75 per cent of carbon, when seen under the microscope presents a tolerably flat surface, composed of innumerable small, sharp crystalline points, while that of iron is rough, more or less fibrous or mossy, and the



fibres do not end in sharp points. These fine crystalline points in the steel, as is well known, must facilitate the evolution of bubbles; consequently they are very small, rapidly given off, and hence invisible to the naked eye, whilst the absence of these points in iron causes the small bubbles to collect into larger ones, which are readily seen.

The less carbon a steel contains the more its fracture will resemble iron, so in a steel containing only 0.21 per cent of carbon small bubbles may sometimes be seen by the naked eye.

About 5 ozs. of iron wire 0.125 in. diameter, after ten days' immersion in hydrochloric acid 1.20 sp. gr., was well washed in water, dried and placed in a glass tube heated to a temperature of a little over 100° C. by a sand-bath. Each end of the tube was connected with a bottle containing nitrate of silver solution. A current of air was then slowly drawn through the tube for two to three hours without forming any precipitate, however, of chloride of silver; but the surface of the iron was covered with a coating of oxide, or, in all probability, oxychloride of iron.

Thick pieces of iron, 0.450 in. diameter, were found to redden blue litmus-paper slightly when applied to the fracture after the iron had been immersed twelve hours in hydrochloric or sulphuric acid.

Mr. J. CARTER BELL communicated a series of meteorological observations which have been made daily during the months of May, June, July, and August, 1873, at Tumaco, New Granada, South America, by Mr. G. Wilcynski.

"On Crystalline Sublimed Cupric Chloride," by S. CARSON (Student in the Chemical Laboratory of the Owens College).

Cupric chloride, prepared by burning copper in dry chlorine gas, or by heating the anhydrous salt to 200°, is obtained either as a brown sublimate or as a brownish yellow powder.

A mass of a copper compound, crystallised in needles, many exceeding 5 m.m. in length, as found in the decomposer of the Deacon chlorine process, was forwarded to Professor Roscoe by Mr. Worsley, of the Netham Chemical Works. The crystalline mass was collected from the space above the marbles, impregnated with copper sulphate at the top of the compartments. The temperature of this space is always necessarily a little lower than that of the spaces between the marbles where the action takes place, and to this is attributed the deposition of the compound.

I have made several analyses of these crystals, the results of which show that they consist of anhydrous cupric chloride, mixed with a small quantity (about 2 per cent) of an insoluble oxychloride. The following is a mean of several analyses of the soluble portion:—

	Calculated.	Found.
Copper	47.172	46.909
Chlorine	52.828	53.091
	100.000	100.000

The formation of this crystalline sublimate appears to take place as soon as the temperature of the marbles covered with sulphate of copper reaches about 800°. In all probability a formation of copper chloride is constantly occurring as a necessary step in the decomposition of the hydrochloric acid and air, and when the temperature reaches the volatilising-point of the chloride these crystals appear.

As the greatest amount of decomposition of the hydrochloric acid takes place close upon the temperature at which the chloride sublimes, the formation of this salt and the consequent loss of copper has been a fertile source of annoyance to the manufacturer.

Mr. Deacon has recently completely overcome this difficulty by the addition of sodium sulphate to the copper sulphate with which the marbles are impregnated.

The presence of this salt prevents any formation of copper chloride, sodium chloride being volatilised, and copper sulphate remaining behind. This reaction is well seen by the change of colour from green to blue, produced when a solution of sodium sulphate is added to one of cupric chloride.

CORRESPONDENCE.

PINK AND WEBSTER'S "ANALYTICAL CHEMISTRY."

To the Editor of the Chemical News.

SIR,—Amongst the various books on chemistry which have recently appeared, my attention has been called to a work entitled "A Course of Analytical Chemistry (Qualitative and Quantitative), by William W. Pink, Practical Chemist and Metallurgical Analyst, and George E. Webster, Lecturer on Metallurgy and the Applied Sciences, Nottingham." The value of this work, which forms a portion of Weale's Educational Series, will be appreciated after a perusal of a few extracts.

On p. 42, we learn, under the head of Reagents, the following property of "baric chloride, BaCl_2 ":—"The solution of this salt must be neutral after precipitation of SO_2HO_2 , sulphuric acid."

We are next told (p. 43) that " CONaO_2 , sodic carbonate, must completely volatilise." It would be interesting to know at what temperature this phenomenon takes place.

As specimens of the lucid English with which the work abounds, I may quote from p. 121, Manufacture of Oxygen—"a little MnO_2 , manganic oxide, or Fe_2O_3 (peroxide, sesquioxide, or red oxide of iron) added, reduces the heat required for the giving off of the oxygen, but is liable to contaminate it by traces of Fe or Mn and from potassic chloride." The conclusion of this sentence seems unintelligible.

Again, on p. 129, we have "measuring-flask can be more easily obtained than made." : "If, however, the student has some practice in manipulating, measuring-flasks are simple articles."

On p. 123 the following statement occurs:—"Copper is prepared by the electrolytic method, or by precipitating the metal from a solution of sulphate, and then freeing from iron by boiling in hydrochloric acid, after which wash, dry, and roll into sheets." Anyone who has seen the pulverulent condition of copper deposited from solution by the action of iron will appreciate the difficulty attending the process of rolling it into sheets.

I must now turn to the quantitative portion of the work, and may premise by saying that most of the processes recommended pre-suppose that the operator has a solution of the substance to be estimated entirely free from other salts; this is surely a condition rarely met with by the analyst. The most frequent, and indeed almost universal, method of estimation appears to be—"add sulphuric acid, evaporate to dryness, and ignite." This is apparently applicable to the determination of barium, strontium, magnesium, sodium, potassium, calcium, and lithium; whilst the estimations of magnesium as pyrophosphate, and of potassium as a double chloride of platinum and potassium, are entirely omitted.

In that portion of the work treating of the "Estimation of Non-Metals," we have (p. 166) an account of the means to be employed for the conversion of sulphur into sulphuric acid, but nothing is said with regard to estimation. On the same page, we are instructed to "evaporate to dryness and then heat gently to dryness."

In the estimation of copper as cupric oxide, the student is told (p. 148), with regard to the precipitate to "ignite intensely, and weigh as soon as cool." : "If the solution, however, be ammoniacal, the precipitate must be weighed whilst hot, as, if allowed to cool, a small portion of the precipitate would re-dissolve." I should be glad to learn in what the precipitate is to re-dissolve after intense ignition.

In conclusion, I may give one more extract. In speaking of chloride of silver, the authors state that, "when the chloride is thoroughly dry, an ejection often takes place, occasioned by the silver imbibing oxygen and then allowing it to escape (called occultating)."—P. 145.

I only call attention to a few of the worst blunders, and

would ask the probable results of a student's efforts in pursuit of knowledge were he to follow the recommendation of the authors (preface) to "practically follow the course as laid down."—I am, &c., A. G. P.

ESTIMATION OF SILICON AND GRAPHITE IN PIG-IRONS.

To the Editor of the Chemical News.

SIR,—It seems to me that the method of estimating silicon and graphite in pig-irons which is described by Mr. Piesse in the CHEMICAL NEWS, vol. xxix., p. 57, is open to objection on the following grounds:—The original action of the sulphuric acid on the silicide of iron results in the formation of a partially oxidised compound of silicon (probably leucon), and, unless this is completely oxidised to silica by the treatment with nitric acid, the loss on ignition will be too low (and, therefore, the graphite estimation erroneous), to say nothing of the indefinite amount of water retained by the leucon. Indeed, it seems to me very unsafe to assume that silica dried at 100° C. always contains 6 per cent of water, though I certainly have never attempted to ascertain the composition of such silica. Mr. Piesse's method also involves the drying of a weighed filter, always an objectionable process. When the iron contains combined carbon as well as graphite, there is great danger of some of the former producing an insoluble compound and remaining with the silica and graphite, thus increasing the apparent amount of the latter. Evaporation with nitric acid does not destroy this carbonaceous body, but it can be dissolved by alkalis.

I presume Mr. Piesse's experience has been chiefly confined to the analysis of irons containing but little graphite, or he would scarcely speak of burning it off in "two or three minutes in a muffle," even in the presence of the silica.

The determination of graphite and silicon being an every-day matter in Sheffield, I have taken some trouble to ascertain the method by which accurate results could be obtained most rapidly. The process adopted is not novel, except in one or two minor details. The results often agree to the second place of decimals.

The iron is just covered with water, and treated with hydrochloric acid of sp. gr. 1.11. The liquid is boiled for about half an hour, when the iron (if grey) is entirely dissolved, the silicon being chiefly converted into leucon, which floats on the surface as a very bulky white mass. The liquid is diluted with hot water, filtered, and washed first with acidified, and then with pure, water. The residue is next washed off the filter (a very easy operation) into a large silver or platinum crucible, in which is placed a lump of pure hydrate of potassium about equal in weight to the iron taken. The leucon dissolves, with evolution of hydrogen and formation of soluble potassium silicate, while any carbonaceous compounds also pass into solution with brown colour. The liquid is heated nearly to boiling for a short time, diluted, and filtered. The filtrate is added to the acid solution of the iron, evaporated to dryness, &c., and the silica obtained calculated into silicon. The graphite on the filter is washed off, boiled with a little aqua regia to dissolve any iron which may have previously escaped solution (as is often the case with spiegel-eisen and white irons generally), the liquid again filtered, the graphite washed, and rinsed off into a platinum crucible, where the water is evaporated to dryness, and the graphite strongly dried. The graphite so obtained is nearly pure, but I always burn it away, and take the loss on ignition as the true amount. If a large residue (more than 0.1 per cent of the iron taken) is left after ignition, the result is not reliable, the tendency being to render graphite estimation too high. The error seems to be due to the formation of an oxychloride of iron, decomposed on ignition, with production of volatile ferric chloride, thus increasing the loss of weight. It is only by very bad management such an accident can occur. In iron containing much titanium, the residue left after combustion

of the graphite may be very considerable without affecting the accuracy of the results. The residue never contains silicon.

The above method will doubtless take longer in the execution than that recommended by Mr. Piesse, but it is free from the serious sources of error of the latter process, and gives remarkably concordant results in practice.

With respect to the method of determining sulphur recommended by Mr. Piesse (vol. xxviii., p. 248), I may say that the analyst who follows the instructions there given will infallibly get too low a result, on account of the time allowed by Mr. Piesse (twelve hours) being quite insufficient for the perfect precipitation of the barium sulphate. The presence of excess of hydrochloric acid, which will certainly be present if Mr. Piesse's directions are followed, greatly retards, if it does not altogether prevent, the precipitation of BaSO_4 , and if Mr. Piesse carefully neutralises his filtrate with ammonia, and allows it to stand another twenty-four hours, he will find a considerable additional precipitation of barium sulphate will take place. For the complete precipitation of the very small quantities of sulphur present in iron, it is necessary to neutralise the liquid as closely as possible with ammonia before adding barium chloride, and to allow twenty-four or thirty-six hours for the precipitation.—I am, &c.,

ALFRED H. ALLEN.

SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

SIR,—The letter of "J. B. S." (vol. xxix., p. 71) strikes at an existing evil, but I think not at the root of it. It would be preferable to advise those engaged in the manufacture of sulphate of ammonia to make sulphate of ammonia instead of acid sulphate of ammonia. The former being rapidly crystallised from a slightly alkaline solution requires no drying, and contains its proper percentage of ammonia, and will not absorb moisture from the atmosphere. Whilst the latter allowed to crystallise slowly from an acid solution, even if dried, will not contain its proper percentage of ammonia, and will be ever ready to absorb moisture. Thus the cause of our wet sulphate of ammonia appears to rest more with the manipulation than with the "hasty packer," though insufficient draining may frequently occur and tell upon the balance.—I am, &c., G. J. S.

PRODUCTION OF AMMONIA.

To the Editor of the Chemical News.

SIR,—In your last issue you describe a process for the production of pure ammonia by reducing a nitrate with sodium amalgam. I believe this method was first suggested by me in the CHEMICAL NEWS, vol. xviii., p. 179, as a means of detecting nitric acid in potable waters, though no doubt this fact had escaped your observation. the reaction being indeed sufficiently obvious.—I am, &c.,

THOMAS P. BLUNT, M.A. Oxon, F.C.S.

Physical Society.—A numerous-attended meeting was held on Saturday last in the Physical Laboratory at the Science Schools, South Kensington, for the purpose of establishing a Physical Society in London. The chair was taken by Dr. J. H. Gladstone. The bye-laws prepared by the Organising Committee appointed on Nov. 29 were received and amended. The following were chosen officers for the first session:—*President*—Dr. J. H. Gladstone, F.R.S. *Vice-Presidents*—Prof. W. G. Adams, F.R.S., and Prof. G. C. Foster, F.R.S. *Secretaries*—Prof. E. Atkinson, and Prof. A. W. Reinold. *Treasurer*—Prof. E. Atkinson. *Demonstrator*—Prof. F. Guthrie. *Other Members of Council*—W. Crookes, F.R.S., Prof. A. Dupré, Prof. T. M. Goodeve, M.A., Prof. O. Henrici, B. Löwy, Dr. E. Mills, and H. Sprengel.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

OTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, December 29, 1873.

Researches on Isomerism in Albumenoid Substances.—M. A. Bechamp.—The author having studied the products of the oxidation of albumenoid bodies by permanganate of potassa, had occasion to determine the rotatory power of white of egg. This was comprised between 40° and 42° to the left. Among the products of the oxidation of this albumen were certain compounds possessing an acid reaction, whose rotatory power, in the same direction, amounted to 43° , 49° , 52° , and even 56° . It was evident that the white of egg contained several albumenoid bodies possessing unlike rotatory powers. Soluble albumen, prepared by the process of Wurtz, has a rotatory power of 30° to 34° to the left. In the white of egg it is accompanied by at least another body, having a higher rotatory power in the same direction. In the white of a hen's egg there are, besides the soluble albumen of Wurtz, two others equally soluble in the same conditions. One is a ferment capable of converting starch into the soluble modification, but without the formation of dextrin or of glucose. It remains soluble in water after having been precipitated by alcohol. The rotatory powers of these three bodies are—

Soluble albumen (Wurtz)	$[\alpha]_D^{20} = 33^\circ$	in water.
" " "	$[\alpha]_D^{20} = 32.7^\circ$	with the addition of acetic acid.
" " "	$[\alpha]_D^{20} = 34.4^\circ$	with the addition of carbonate of soda.

Another soluble albumen	$[\alpha]_D^{20} = 53.6^\circ$	in water.
Egg ymose	$[\alpha]_D^{20} = 70.8^\circ$	in water.
All to the left.		

In the yolk there are three matters; the first, an insoluble and probably organised albumenoid, forms the largest part of the vitelline. When freed from all accompanying substances it liquefies starch. The other two albumenoids of the yolk are soluble in water. One of them is rendered insoluble by alcohol, whilst the other remains soluble, and acts as a ferment upon starch, though without saccharifying it. Its rotatory power is 46.5° to the left. The author names it lecithozymose. The albumenoid matters of cow's milk are also mixtures of distinct bodies, having widely different rotatory powers. The casein of new milk, dissolved in carbonate of soda, has a rotatory power of 109.7° to the left. Galactozymose, the ferment of milk, has the power 40.7° also to the left. M. Bechamp is still prosecuting these interesting researches. The methods by which he separates these isomeric albumenoids will be made public on a future occasion.

Action of Water on Sheet-Lead.—M. H. Maraes.—The author considers sulphide of hydrogen as the most sensitive reagent for salts of lead in water. It gives with milk containing 1-10,000th of lead a flesh-red colour. The author does not admit that the presence of calcareous carbonate and sulphate renders water incapable of acting upon lead. Turnings of lead, placed in water containing an excess of the carbonate and bicarbonate of lime, were gradually acted upon, and after standing for twenty days the water was distinctly coloured by sulphide of hydrogen.

Researches on the Hydride of Arsenic.—M. Engel.—It has been long admitted that the deposit formed on treating arsenide of zinc with hydrochloric acid is hydride of arsenic. The author, criticising the experiments of Wiederhold, maintains with Soubeiran that hydride of arsenic is not produced under these circumstances.

Action of Iodine on Uric Acid.—M. F. Wurtz.—When iodine is introduced into uric acid held in suspen-

sion in water the iodine disappears, and the uric acid is decomposed, yielding alloxane, hydriodic acid, and probably urea.

Synthesis of Oxalyl-Urea (Parabanic Acid).—M. E. Grimaux.—The author causes oxychloride of phosphorus to react upon oxaluric acid, and obtains parabanic acid. He is attempting to prepare succinyl-urea by the reaction of oxychloride of phosphorus upon succinuric acid.

Formation of Equations of Condition from Observations of the Transit of Venus.—M. Puiseux.—Various observations will be made during the transit; the hour of external and of internal contact, the angular distance of the two centres, the angle made by the line of centres with determinate directions, the projection of the distance between the centres on the celestial meridian passing through the sun's centre, or on the parallel at that point or any other direction; each of which will lead to an equation of condition between the various unknown quantities. The author seeks to facilitate the calculations connected with these equations by determining, in advance, certain numbers which enter into them, or at least constructing tables whence they may be readily deduced.

New Reply to M. Pasteur on the Origin of Beer-Yeast.—M. Trecul.

Theoretical Essay on the Equilibrium of Elasticity of Pulverulent Masses, and on the Thrust of Earths that are without Cohesion.—Extract from memoir by M. Boussinesq.—The equilibrium here studied is that produced in a sand mass which is at rest, and is supported by a wall firm enough not to be liable to shaking.

New Arrangement of the Hydro-Electric Sulphate of Copper Pile (M. Becquerel's).—M. Trouvé.—The salts of copper and zinc are simply maintained in contact with the metals (of same name) by the capillary action in rolls of paper. The pile is very portable, has the same electromotive force as an ordinary sulphate of copper pile of the same number of couples, and may act continuously for a long time if placed in a closed vessel to obviate desiccation.

Certain Relations between the Colouration of Birds and their Geographical Distribution.—M. Alph. Milne-Edwards.—The author remarks that in certain ornithological families (swans and parrots, *e.g.*) the tendency to melanism, or black plumage, only appears in the Southern Hemisphere, and more particularly in the region comprising New Zealand, Papua, Madagascar, and intermediate parts.

Waterspouts and Whirlwinds.—M. Mouchez.—The author recounts some of his own observations. It is very common (he thinks) in using the name *trombe* to confound two meteors that are quite different in causes and effects. One of these, the whirlwind or cyclone, occurs when two neighbouring layers of a moving fluid, accidentally made to deviate, meet at angles, or with different velocities. The molecules in the line of meeting are subjected to a couple, which produces the gyration. The whirlwind may take a second movement of translation in the direction of the component of the two currents giving rise to it. The essential condition of the phenomenon is a wind. Clouds may or may not be present. The *trombe*, on the other hand, always forms at the base of a dense nimbus cloud, and only in dead calm, or with a faint breeze; a moderate wind dissipates it at once. A protuberance descends from the cloud towards the sea, and presently takes the form of a column or tube which remains vertical, or if there is a breeze undulates slightly. When this tube, which is sheathed at the upper part by a more diffuse tube, has reached about $\frac{1}{2}$ of the height of the cloud the water surface below begins to boil: then, at a short distance, one may distinctly see a jet of vapour rise from the sea like a vertical sheaf about the base of the *trombe*, if that is vertical, or oblique, and with angle of reflection equal to angle of incidence, if the *trombe* is inclined. While the emission of vapour or of water takes

place, the tube gets clearer and clearer, and ends by appearing under the form of two distinct dark lines. When the vapour-jet has ceased the *trombe* seems to have finished its work; for it begins to dissolve at its lower part and to rise again, gradually, to the cloud, in which it is at length lost. This is the general type of the phenomenon, but there are some singular modifications. Sometimes there is a series of two or three concentric tubes, the external ones shorter than the internal. In one case observed, the tube instead of dissolving after cessation of the vapour-jet seemed transformed into a kind of chimney, within which little flocks of vapour could be seen gradually rising towards the cloud, and oscillating from side to side (which may have led to the opinion that the movement in *trombes* is from below upwards). In another case the *trombe* seemed like a tube closed below, or a very long bag. The lower part was rounded and darker than the rest. The sea boiled under it as under open tubes. This is the only case, M. Mouchez thinks, in which electricity might be called in to explain the effects. Once more; there are *trombes* which have their two extremities widened in form of a funnel; the lower mouth seems to enlarge as though under strong pressure, and the water-jet is a diverging one, like that from the rose of a watering-pot. One cloud may produce several *trombes*, some of which are dissipated before full development. A fully formed *trombe* seems to become adherent to the point of the sea which it meets, for its base remains unmoved when the cloud above takes a slight movement of translation; one sees it then becoming more and more inclined, elongated, and then torn asunder before having passed through all its phases. M. Mouchez never observed lightning or thunder accompany *trombes*. Rain rarely precedes, always follows, but never co-exists with the meteor. From measurements he made, the lower diameter seems to have varied between 5 and 20 metres, the upper diameter being twice or thrice as great, the height of the cloud between 200 and 500 metres. The *trombe* lasts from ten to twenty minutes. The chopping of the sea covers a circle four or five times greater than the diameter of the tube. The height of the waves never reaches one metre. None of the *trombes* the author saw would have been at all dangerous to a ship; they would probably have occasioned nothing more than a good bath of water or vapour. There is no violence in the phenomenon. It thus quite differs from that sometimes described as occurring in the middle of a tempest, a huge mass of water being raised, whirlwind-wise, and threatening shipwreck. The author states that he has never seen these tempest *trombes*; which, if real, must have quite different causes from those described. The impression produced by the latter is that of a mass of air, suddenly cooled, descending by its own weight through clouds having a certain force of cohesion. This explanation goes to confirm the view that there is a *descending* movement in *trombes*. In whirlwinds, on the other hand, one sees nearly always an *ascending* movement in the direction of the axis, which results in a longer duration of the meteor. We have here an essential difference between the two phenomena which are so often confounded.

Bulletin de la Societe Chimique de Paris, tome xx., No. 10, November 20, 1873.

On Pentachlorated Benzins.—M. A. Ladenburg.—An addition of some details to the author's former paper on the subject.

Oxalins—a New Class of Ethers of the Polyatomic Alcohols properly so called; New Characteristic of these Alcohols.—M. Lorin.—The author gives the experiments which enabled him to affirm the existence of the oxalins. The property of producing oxamide when heated with oxalic acid and mixed with ammonia may serve to detect and define the chemical function of an alcohol.

Rotatory Power of the Hyposulphates.—M. E. Bichat.—The author supports the view announced by

M. Pape that the crystals of the hyposulphates of potassa, lead, strontia, and lime have a rotatory power. Those of hypo-sulphate of potassa belong to the regular hexagonal system.

Solubility of Arsenious Acid in Water.—M. L. A. Buchner.—1 part of crystalline arsenious acid dissolves, after 24 hours digestion, in 355 parts of water at 15° C. The amorphous acid, in the same conditions, requires 108 of water. If the crystalline acid has been dissolved at a boiling heat, and the solution left to stand for twenty-four hours, it contains to 1 part of acid 46 of water. The amorphous acid, in the same circumstances, remains dissolved in 30 parts of water.

Reduction of Carbonic Acid and Carbonic Oxide by Phosphate of Iron.—M. S. H. Horsford.—The author has found that when carbonic acid and a mixture of phosphate of soda and green vitriol with a little water are introduced into a tube, the carbonic acid is gradually reduced to carbonic oxide. The author considers this phenomenon as very important for vegetation.

On Tempering Steel for Tools.—The following procedure, due to M. Kulicke, is in use at the works at Saarbruck. It serves to restore the nature of steel altered or burnt, and consists in plunging the article—previously brought to a cherry-red heat and forged for an instant—into the following mixture, and then into cold water. Tartaric acid, 12 parts; fish-oil, 60 parts; powdered charcoal, 4 parts; bone-black, 16 parts; yellow prussiate, 20 parts; tallow, 20 parts; burnt stag's horn, 6 parts.

Reimann's Farber Zeitung, No. 47, 1873.

This number contains receipts for a light silver-grey and a steel-blue on plush, a bluish drab on wool, an orange and a grain-scarlet on woollen-yarn, a black and a chamois on cotton-wool.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxiii., No. 15, December 11.

Action of Water, and of Certain Solutions of Neutral Salts upon Sugar.—W. L. Clasen.—The author refers to the experiments of Soubeiran, Berthelot, Maumené, and Bechamp, and seeks to verify their results by employing both polarised light and the cupro-potassic liquor. He confirms the disputed view of Maumené—the transmutation of sugar into inverted sugar at common temperatures, and without any notable formation of mould. The author adds that it is not possible to determine glucose by the saccharimeter, as the errors of observation exceed the effect of the glucose produced. The determination can only be made by means of the cupro-potassic tartrate, which other carbo-hydrates have also the power of reducing.

On Turacin.—J. J. Monteiro.—The author fully confirms the results of Church as to the presence of copper in the feathers of the Touraco. Copper exists in the regions inhabited by the bird in the state of green carbonate (malachite).

No. 3, January 15, 1874.

Use of Sulphide of Cadmium for Colouring Soaps.—To detect zinc-white, which is often present as an impurity in the cadmium compound, the suspected sample is digested in acetic acid. On adding carbonate of soda to the solution thus obtained, a white precipitate is formed if zinc be present.

Mordanting with Alum.—According to Havrez the alum used for this purpose should not exceed 1-10th of the weight of the goods to be dyed, or the hydrate of alumina at first deposited on the fibre will be re-dissolved, producing thus flat and meagre shades.

Improvement in the Manufacture of Bread.—E. du Mesnil.—The author, in opposition to Pasteur, ascribes fermentation to the action of oxygen, the formation of a

gaseous electric pile, and the decomposition of water, which "furnishes to the saccharine matters, on the one hand, the carbonic element, and, on the other, the element of alcohol.

MISCELLANEOUS.

Chemical Appointment.—The Japanese Government have, through their Legation in London, appointed Mr. R. Routledge, B.Sc., F.C.S., to the Professorship of Chemistry and Physics in the Imperial College at Yeddo. Mr. Routledge studied science at the Owens College, Manchester, where he had Dr. Roscoe for his instructor in chemistry, and took a distinguished place in the Honours Examinations of the University of London in 1869 and 1870.

Report of the Public Analyst for the Strand District.—Mr. C. H. Piesse, the Analyst for the Strand District, laid his report before the Board of Works for that District on the 11th inst. Of 121 samples of various articles of food analysed by him during the past three months, only one (a sample of milk) was adulterated. Much attention had been given to "patent" articles of food, and to substances sold as "mixtures." He pointed out as a result that it was advisable to make the terms of the Adulteration Act quantitative, instead of merely qualitative. Very slight modifications of Clauses 3 and 7 would effect the alteration. Under Clause 3 it should be compulsory for the vendors of "mixtures" to state not only the nature of the admixtures, but also the quantities of them in proportions of 100 parts, and under Clause 7 the Analyst to report quantitatively in addition to the qualitative statement now required; and he proposed that the suggested alterations should be brought before the Government by the Board. The other points were of merely local interest.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the electro-deposition of tin. Thomas Fearn, Birmingham, Warwick, electro-metallurgist. April 7, 1873.—No. 1277. This invention consists of solutions made and used in the manner described for the deposition of tin by electricity. One solution consists of a solution of protochloride of tin, to which are added a solution of hydrate of potash and a solution of cyanide of potassium, and, lastly, a solution of pyrophosphate of soda. Another solution consists of a solution of protochloride of tin, to which are added a solution of pyrophosphate of soda and a solution of muriate of ammonia. Another solution consists of a solution of protochloride of tin, to which a solution of muriate of ammonia is added. Another solution consists of a solution of protochloride of tin, to which are added a solution of tartrate of potash and a solution of hydrate of potash. The proportions of the several solutions which are mixed together are described, also the battery power employed, and the temperature of the solutions.

Improvements in the utilisation of waste products of ammoniacal liquor. Arthur William Ellis, manufacturing chemist, Madeira Villas, Woodford, Essex. April 8, 1873.—No. 1285. The precipitation and collection of cyanogen substances from the hitherto wasted (or spent) liquor produced in the distillation of ammoniacal liquor.

Improvements in the treatment of night-soil, of sewage deposits, and of other similar moist manurial matters. Gustav Alsing, civil engineer, 3, Bank Place, Preston. April 9, 1873.—No. 1319. This invention consists in a method of rapidly fixing or solidifying moist night-soil, sewage, slush, or other similar moist manurial matters, in order to render such material conveniently portable and capable of being inoffensively stored for use as manures, by mixing it with a certain proportion of sulphate of calcium or burnt gypsum, commonly known as plaster of paris. In order to facilitate the mixing process I use special constructed receptacles, which, by means of worms or screws driven by differential speed-pulleys, deliver the material to be mixed in certain proportions, after which they are mixed in a cylinder and discharged in the form of bricks, or other forms, by filling it into suitable troughs, which may be divided into partitions.

Improvements in the manufacture of artificial fuel. David Barker, Northfleet, Kent. April 10, 1873.—No. 1321. This invention consists in combining coal, coke, and other carbonaceous materials, with a mucilage or liquid formed of farina, water, and a solution of sulphate of alumina or chloride of alumina in hydrochloric acid, pitch and carbolic acid being added thereto, the resulting compound being moulded into blocks, and in some cases, as for instance for blast furnace purposes, a process of re-coking is resorted to.

Improvements in the destructive distillation of shale or other oil-yielding minerals, and in apparatus therefor. Norman McFarlane

Henderson, manager of the Oakbank Oil-Works, Mid Calder, Mid Lothian, North Britain. April 10, 1873.—No. 1327. In carrying out the invention according to one modification, a series of four vertical retorts are arranged, in a furnace or oven, with their bottom ends at a little distance above a central fire space or grate. The bottom ends of the retorts are provided with doors capable of being closed gas-tight, and immediately below each door there is an inclined valve which in one position separates the bottom of the retort from the central fire-space, whilst it can be turned over outwards to form an incline down which the spent shale may fall into the fire-space. The four retorts are, by preference, to be drawn and re-charged at separate equidistant periods. More or less of the permanent gas formed during the destructive distillation may be led into the fire-space to aid the combustion, as is ordinarily practised with coal fires.

Improved process or treatment and compositions or compounds for the improvement, waterproofing, and preservation from mildew and moths of silk, wool, cotton, furs, leather, paper, and other articles. William Morris, a citizen of the United States of North America, at present residing at No. 80, Caversham Road, Kentish Town, Middlesex. April 12, 1873.—No. 1344. This invention relates to a new process or treatment and compositions for the improvement of manufactures formed of silk, wool, cotton, flax, or hemp; also furs, leather, and paper; by means of which such manufactures are made incapable of capillary attraction, are rendered waterproof, and not liable to mildew, nor to be attacked by moths; their strength and durability are increased, their porosity is unimpaired, and their general quality and appearance are improved; and by the same process wood is rendered impervious to moisture, and incapable of generating mildew, fungi, &c.; and bricks, tiles, and other articles, are made moisture-proof. The process consists of two steps or parts, as follows:—For the first part is used a chemical compound which consists of, say, one part of dry gelatin (isinglass or other), dissolved in, say, four parts of oil, including a small quantity of sulphuric or other acid, and, when these are combined by means of heat, five parts (or thereabout) of an alkaline solution are added, at a specific gravity of about 26° Baumé, the whole being stirred while yet warm, and the result is a chemical combination designated the "preparatory compound." For the second part of the process is used a chemical compound, designated the "perfecting compound," and which is prepared as follows, namely:—In one vessel is prepared a strong solution of one of the alums, for instance, of the sulphate of alumina, with potassa, or with ammonia, or with soda. In another vessel is prepared a solution of the sulphate of zinc, and in a third vessel a solution of the acetate of lead. These solutions are each to be of the same density. When prepared, the two sulphate solutions are mixed in the proportion of about five parts of the first named to one and a half parts of the latter named, and to these are added about five and a half parts of the acetate of lead solution. By the chemical action that ensues sulphate of lead is formed, and when this has subsided the clear liquid is drawn off, and is reduced to the proper density, which is from 1 to 2° Baumé. The materials to be treated are steeped in baths of the above compounds, or in some cases the preparatory compound may be applied by hand. Some kinds of paper need not be submitted to the preparatory compound.

MEETINGS FOR THE WEEK.

MONDAY, Feb. 23.—Medical, 8.

— Geographical, 8.30.

— London Institution, 4.

TUESDAY, 24.—Royal Institution, 3. Prof. Tyndall, "On the Physical Properties of Liquids and Gases."

— Civil Engineers, 8.

— Anthropological, 8.

WEDNESDAY, 25.—Society of Arts, 8.

— London Institution, 7.

— Geological, 8.

THURSDAY, 26.—Royal Institution, 3. Prof. W. C. Williamson, "On Cryptogamic Vegetation."

— Royal, 8.30.

— Philosophical Club, 6.

FRIDAY, 27.—Royal Institution, 8; Weekly Evening Meeting. Mr. Francis Galton, "On Men of Science, their Nature and Nurture," 9.

SATURDAY, 28.—Royal Institution, 3. Mr. R. Bosworth Smith, "On Mohammed and Mohammedanism."

TO CORRESPONDENTS.

ERRATUM.—Vol. xxix., p. 78, line 21 from bottom, for "no consequence" read "of consequence."

W. W. Roberts.—An answer to your question would require a detailed chemical examination of the sample, which does not come within the province of "Answers to Correspondents."

Professor Tennant's Lectures on Rocks and METALLIC MINERALS at King's College are given on Wednesday and Friday mornings from 9 to 10 o'clock, and on Thursday evenings from 8 to 9. The lectures commenced Thursday, January 22nd, and will be continued to Easter.

PRIVATE INSTRUCTION in GEOLOGY and MINERALOGY can be had by Professor TENNANT at his residence, 149, Strand, W.C., by those unable to attend public lectures.

THE CHEMICAL NEWS.

VOL. XXIX. No. 744.

ALUM IN BREAD.

THE case of the two Harrow bakers who were charged at the Edgware Petty Sessions with selling bread containing alum in the proportion of 40 grains to the 4-lb. loaf presents many points of interest, and offers another striking example of the difficulties which surround the detection of this description of adulteration.

The facts of the case are as follows:—A few weeks ago a certificate signed by Dr. Redwood, Public Analyst for Middlesex, was produced before the magistrates. This certificate sets forth that certain samples of bread sold by these bakers contained 40 grains of alum in 4 lbs. of bread; and on the strength of this certificate the magistrates were asked to inflict the penalty prescribed by the recent Adulteration Act.

On the other hand, the bakers denied the charge of aluming the bread, and applied for an analysis by an independent chemist, and their application was granted. A portion of each of the samples of bread was accordingly sent to Mr. Wanklyn (who holds office as Public Analyst for Buckinghamshire), and on Wednesday, the 18th inst., Mr. Wanklyn's analysis was produced at the Edgware Petty Sessions, and the adjourned hearing of the case proceeded with.

From the report of the case, which is before us, we gather that Dr. Redwood gave evidence that he had certified to the presence of 40 grains of alum in the 4-lb. loaf, because he had obtained 0.2 grain of a white precipitate from 1000 grains of the bread by a well-known process for the detection of alum in bread.

This process is described in Watts's "Dictionary," and is, we believe, known, as Kuhlmann's process.

Dr. Redwood gave evidence that he had burnt up 1000 grains of the bread in a platinum dish, and then treated the ash with a considerable quantity of nitric acid, and evaporated down to complete dryness in a porcelain dish. The residue was then treated with a few drops of acid and water, boiled, and filtered. The filtrate was then neutralised with carbonate of soda, and then mixed with some solution of pure potash, and boiled in a porcelain dish. After filtration the filtrate was then supersaturated with hydrochloric acid, and rendered alkaline with ammonia or carbonate of ammonia, and boiled, when it gave a precipitate which weighed about 0.2 grain. This precipitate Dr. Redwood said was alumina, and calculating on that basis he certified that the 4-lb. loaf contained about 40 grains of alum.

Mr. Wanklyn, on the other hand, had burnt up 1500 grains of the bread at a very low temperature, and had avoided using porcelain dishes, and did not obtain any precipitate. He did not find any alum.

In the course of the trial it was pointed out that the 0.2 grain of white precipitate which Dr. Redwood said he had obtained could not possibly be alumina, but must have been phosphate of alumina, and that accordingly Dr. Redwood's analysis (assuming its correctness) would only show about 20 grains of alum in the 4-lb. loaf, and not about 40 grains, as had been certified. It was also pointed out that the employment of porcelain was a source of danger.

Under these circumstances the magistrates dismissed the cases.

A correspondence between Dr. Redwood and Mr. Wanklyn on these cases has appeared in the *Circle*. We refer our readers to the correspondence; from which we gather that Dr. Redwood maintains that the precipitate he obtained was alumina.

PRELIMINARY NOTICE ON THE ACTION OF BROMINE ON PROTOCATECHUIC ACID, GALLIC ACID, AND TANNIN.

By J. STENHOUSE, LL.D., F.R.S., &c.

WHEN protocatechuic acid is treated with excess of bromine in the cold, Barth* has shown that one equivalent of the hydrogen is replaced by bromine, giving rise to mono-bromo-protocatechuic acid, $C_7H_5BrO_4$. If, however, protocatechuic acid, or bromo-protocatechuic acid, be heated to 100° with excess of bromine, the reaction which takes place is quite different,—hydrobromic acid and carbonic anhydride are evolved, and the tetra-bromopyrocatechin, $C_6H_2Br_4O_2$, described by Hlasiwetz,† is produced.

As is well known, pyrocatechuic acid, at a high temperature, splits up into pyrocatechin and carbonic anhydride, but this reaction does not take place at 100° . The presence of bromine, however, determines the decomposition of the acid with simultaneous production of the highly brominated tetra-bromo-pyrocatechin. The latter substance, produced in this way, possesses all the properties ascribed to it by Hlasiwetz. It melts at 187° . The best solvent from which to crystallise it is ordinary acetic acid, of density 1.050.

Although the action of bromine alone, on protocatechuic acid, when gently heated with it, does not go farther than the formation of bromo-protocatechuic acid, iodine bromide under similar circumstances causes a more complete decomposition, giving rise to bromo-pyrocatechin.

As gallic acid has the same relation to pyrogallol that protocatechuic acid has to pyrocatechin, it seemed probable that, when treated with bromine at 100° , it might undergo a similar decomposition: on making the experiment this was found to be the case—hydrobromic acid and carbonic anhydride are evolved, and tribromo-pyrogallol is left.

Here also, when gallic acid is gently heated with bromine, a dibromogallic acid,‡ $C_7H_4Br_2O_5$, is produced, but at 100° , in the presence of excess of bromine, the acid is resolved into carbonic anhydride and pyrogallol, which is simultaneously converted into the bromo-pyrogallol.

When tannin is heated to 100° in a sealed tube, with excess of commercial bromine, large quantities of hydrobromic acid and carbonic anhydride are liberated, and the product, after the removal of the excess of bromine, was found to consist entirely of bromo-pyrogallol. If, however, both the tannin and the bromine be very carefully dried, the reaction is quite different—hydrobromic acid and some carbonic anhydride are evolved, but the product consists of a dark-coloured substance of a totally different appearance from the colourless crystals of the bromo-pyrogallol. I have not yet investigated the nature of the product obtained by the action of dry bromine on dry tannin, but the result strongly confirms Schiff's|| view that tannin is merely digallic anhydride.

In the experiment made with undried tannin and commercial bromine, the small amount of water naturally present in these substances was sufficient to convert the tannin into gallic acid, which was then decomposed with formation of bromo-pyrogallol and evolution of carbonic anhydride.

When protocatechuic acid is heated to 100° , with a saturated solution of chlorine in carbon tetrachloride, in sealed tubes, a chlorinated compound is produced crystallising in needles, which may be purified by crystallisation from carbon disulphide. A similar reaction takes place when pyrogallol is treated with a carbon tetrachloride solution of chlorine. These substances I am at present engaged in investigating.

* *Ann. Chem. Pharm.*, cxlii., 246.

† *Ibid.*, cxlii., 251.

‡ Grimaux, *Bull. Soc. Chim.*, [2], vii., 479.

|| *Ann. Chem. Pharm.*, clxx., 43.

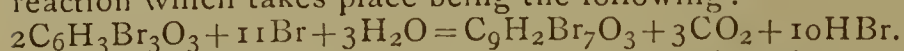
PRELIMINARY NOTICE ON THE
ACTION OF BROMINE IN THE PRESENCE
OF WATER ON BROMO-PYROGALLOL AND ON
BROMO-PYROCATECHIN.

By J. STENHOUSE, LL.D., F.R.S. &c.

ALTHOUGH dry bromine has no action on dry bromo-pyrogallol, even when heated with it for a long time at 100° , yet if water be present a reaction takes place, the nature of which varies with the proportion of bromine and of water employed.

When bromo-pyrogallol is added to about twice its weight of bromine, and then 5 to 10 parts of water are poured on the mixture, there is a slight development of heat, and both the bromine and the bromo-pyrogallol dissolve, forming a deep orange-coloured solution. If this be now gently heated to about 70° or 80° C. it commences to effervesce from the evolution of carbonic anhydride, and in a few minutes bright yellow crystalline plates begin to form, which increase in number until, after the lapse of about ten minutes, the reaction may be considered as terminated. It is not absolutely necessary to heat the solution to obtain this result, as the same compound is produced on allowing the liquid to stand for some days at the ordinary temperature.

This new compound has a composition which may be represented by the empirical formula, $C_9Br_7H_2O_3$, the reaction which takes place being the following:—



A determination of the amount of hydrobromic acid produced in this reaction corresponded pretty closely with that required by the above equation. In this experiment if the amount of water be largely increased—to 20 parts or more—the yellow substance is still formed, but in smaller quantity, and is, at the same time, accompanied by an oily matter.

The crude compound may be conveniently purified by recrystallisation, first from carbon disulphide, and then from light petroleum. It forms brilliant yellow plates, which melt at 122° C., and are very soluble in ether, carbon disulphide, and benzene, less so in petroleum. They are soluble in alcohol, but decomposition takes place at the same time, with formation of a colourless crystalline compound.

If, instead of treating the bromo-pyrogallol with twice its weight of bromine, only 1 part be added, and then 5 to 10 of water, the whole dissolves as before, yielding an orange-coloured solution; on allowing this to stand, however, for a short time at the ordinary temperature, colourless scales begin to separate, and gradually increase in amount until the mixture, if sufficiently concentrated, becomes semi-solid. This new substance is colourless, and decomposes when gently heated. It is somewhat soluble in water, but does not appear to be converted into the yellow compound when treated with excess of bromine.

Bromo-pyrocatechin, when heated in a water-bath for about ten minutes with 3 parts of bromine and 10 of water, undergoes a change analogous to that which takes place with pyrogallol. The compound produced in this instance consists of dark crimson-coloured plates, which may be purified by alternate crystallisations from carbon disulphide and carbon tetrachloride. It melts at about 139° C., but appears to undergo decomposition at the same time. It is also decomposed by boiling with petroleum.

From some preliminary experiments I have made with the compounds described in this notice, it seems probable that they will yield many interesting derivatives, an account of which I hope soon to be able to publish.

Combination of Monochloro-Aldehyd with Benzol.
—M. E. Hopp treated a mixture of bichlor-ether and benzol with sulphuric acid, and obtained an oily substance which he believes to consist chiefly of the compound in question,

NOTE ON THE SYNTHESIS OF FORMIC
ALDEHYD.*

By Sir B. C. BRODIE, Bart., F.R.S.

IN a former note I communicated to the Society the result of an experiment in which a mixture of equal (or nearly equal) volumes of hydrogen or carbonic oxide had been submitted, in the induction-tube, to the electric action. My expectation in making the experiment had been that the synthesis of formic aldehyd would be thus effected according to the equation $CO + H_2 = COH_2$. The only permanent gas, however, other than the gases originally present in the induction-tube, which appeared in the result of the experiment was marsh-gas. When a mixture of hydrogen and carbonic acid gas were similarly operated upon, the same hydrocarbon, together with carbonic oxide, was formed. I have now, however, succeeded, by a modification in the conditions of the latter experiment, in attaining the object which I originally had in view. Evidence of this is afforded by the following analysis:—The gas analysed was the result of submitting to the electric action equal volumes of hydrogen and carbonic acid. After removal from the gas of carbonic acid and carbonic oxide, and also of a trace of oxygen, 191.2 volumes of gas remained, in which were found at the conclusion of the analysis 2.6 volumes of nitrogen. Deducting this amount of nitrogen, 188.6 volumes of gas remain, containing the residual hydrogen in the gas, together with any gases besides carbonic oxide formed in the experiment. This gas was analysed by the addition of oxygen and subsequent detonation by the electric spark, the absorption of the carbonic acid by potash, and the removal of the oxygen over by pyrogallate of potash. The results of the analysis entirely concur with the assumption that the 188.6 volumes of gas were constituted of hydrogen, marsh-gas, and formic aldehyd in the proportions given below:—

Hydrogen	.. ..	183.2
Marsh-gas	.. ..	0.2
Formic aldehyd	.. ..	5.2

		188.6

The composition of 100 volumes of the gas being—

Hydrogen	.. ..	97.14
Marsh-gas	.. ..	0.10
Formic aldehyd	.. ..	2.76

		100.00

Another experiment was attended with similar results, only that the proportion of marsh-gas was somewhat greater.

The result of this experiment may be considered to be given in the equation $CO_2 + 2H_2 = COH_2 + H_2O$. I have reason to believe that formic aldehyd is also formed in the reaction of hydrogen and carbonic oxide; and that the marsh-gas found (in both experiments) results from the decomposition of this substance, possibly according to the equation $2COH_2 = CO_2 + CH_4$. I do not now dwell upon this subject, as it is my intention very speedily to lay before the Society, together with other matters, the details of the various experiments which I have made in reference to it.

RESEARCHES ON THE ATOMIC WEIGHT OF
THALLIUM.†

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 86).

PREPARATION OF CHEMICALLY-PURE THALLIUM.

a. Commercial sulphate of thallium is dissolved in water, and the cold solution deluged with sulphuretted hydrogen. It is then filtered, heated to ebullition, and poured into

* A Paper read before the Royal Society.

† A Paper read before the Royal Society June 20, 1872.

boiling dilute hydrochloric acid. The solution is filtered whilst hot, and then allowed to cool. The chloride of thallium which crystallises out on cooling is washed by decantation until the washings are free from sulphuric acid, and further purified by re-crystallising twice from water. The chloride of thallium thus obtained is dried, mixed with pure carbonate of sodium, and projected by small portions at a time into pure cyanide of potassium kept in a state of fusion in a white unglazed crucible. The chloride is rapidly reduced to the metallic state; the crucible is then allowed to cool, and the contents exhausted with water. The resulting ingot of metal is well boiled in water, dried and fused over a spirit-lamp* in an unglazed porcelain crucible with free access of air, stirred with a porcelain rod to facilitate oxidation, and finally cast in a porcelain mould. It may be preserved under water which has been boiled to expel the air. This metal was used in the determinations A and B.

b. Ordinary metallic thallium is fused in contact with the air, in an iron crucible made nearly red-hot, and then poured into water. The granulated metal is then exposed to a warm atmosphere to facilitate oxidation, the oxide being frequently removed by boiling out with water. When a considerable quantity of oxide (mixed with carbonate) has been obtained, the solution is heated to ebullition, and a rapid current of carbonic acid gas passed through until the liquid is quite cold, and the excess of carbonate of thallium has crystallised out. The resulting salt is re-crystallised and projected into pure cyanide of potassium kept in a state of fusion in a porcelain crucible at a dull red heat; carbonic acid escapes with effervescence, and the metal is reduced to the metallic state. The whole is then allowed to cool, the soluble salts boiled out with water, and the lump of thallium fused over an alcohol-lamp in a lime crucible, and cast in a lime mould as described further on. With this ingot of thallium, the determination C was effected.

c. Carbonate of thallium, obtained as in process *b*, is covered with a small quantity of water, and decomposed by the current from six Grove's cells. Much peroxide of thallium is deposited, which is removed† and preserved for the preparation of thallium by another method. The reduced thallium is then squeezed into a hard cake, melted in a lime crucible heated by means of a spirit-lamp, and cast in a lime mould. This metal was employed in the determination D.

d. A third portion of carbonate of thallium, obtained as in process *b*, is crystallised several times from water, carbonic acid being passed through during the cooling of the solution. After six crystallisations the carbonate is perfectly white. It is then placed in a porcelain dish, covered with a little water, and decomposed by four Grove's cells. The spongy metal is washed, boiled in pure water, tied up in a linen cloth, and compressed between steel plates in a vice. The hard lump is broken up, put into a porcelain crucible, and melted over a spirit-lamp, no flux being used other than the thallium oxide formed on heating. The metal is constantly stirred with a piece of unglazed porcelain, and cast in a warm porcelain mould. With thallium prepared in this manner the synthetical operations E and F were performed.

e. The peroxide of thallium obtained by the electrolysis of the carbonate (processes *c* and *d*) is dissolved in purified sulphuric acid, evaporated to dryness, and heated strongly to decompose any sulphate of peroxide; it is then dissolved in water, and re-crystallised twice. The sulphate of thallium is then reduced to the metallic state by three of Grove's cells, platinum terminals being employed. The metal is squeezed into a lump, and melted under hydrogen in a porcelain crucible, and cast in a polished steel mould, the heat in this case being produced by the combustion of

pure hydrogen gas. The thallium purified as above was used in the operation G.

f. Chloride of thallium, as obtained by method *a*, is boiled in nitric acid till most of it is converted into sesquichloride. This is washed by decantation until it begins to decompose with separation of peroxide of thallium, and purified by twice re-crystallising. The purified sesquichloride of thallium is dissolved in boiling water and poured into dilute ammonia. The precipitated peroxide of thallium is washed by decantation till chlorine is no longer detected in the washings, and then boiled in a little water with pure sublimed oxalic acid till the whole is converted into oxalate of thallium. This is dried and heated in a crucible until the whole is decomposed into a mixture of metallic thallium and oxide of thallium; the reduced metal is then cast in a mould of polished steel. The ingot was employed in the determination H.

g. Ordinary thallium is dissolved in nitric acid, and the excess of acid driven off by heat, the residue is dissolved in water, and the solution saturated with sulphuretted hydrogen. A slight black precipitate is generally formed, the solution is filtered cold, and is then freed from sulphuretted hydrogen by boiling. Ammonia is then added, which generally produces a faint precipitate of sesquioxide of iron and peroxide of thallium; it is then filtered, and the solution is mixed with oxalate of ammonium, and concentrated till the oxalate of thallium crystallises out. This is freed from nitrate of ammonium by re-crystallising, and the oxalate of thallium decomposed by heat, as in process *f*. The thallium thus obtained is again fused in a lime crucible, a blowpipe-flame being directed downwards on to the surface of the fused metal for about five minutes, till the slag of thallium oxide has united with the lime, forming a semi-fluid pasty mass. The metal is then cast in a lime mould, washed when cold, and kept under boiled distilled water or very dilute acetic acid. With metal purified in this manner the estimations I and K were performed.

Purification of Thallium by Fusion in Lime.

A piece of well-burnt, very dense quick-lime, prepared from black marble, is cut out so as just to fit a porcelain crucible; a hole is then turned in the centre of the lime, and a lump of lime cut into the form of a stopper. This apparatus is then raised to a temperature above the melting-point of thallium over a spirit-lamp, and the cavity in the lime is gradually filled with the metal, previously purified by one of the above processes, which is introduced in lumps. The stopper is then put on, and the heat raised to dull redness and kept so for half an hour; after which the melted metal is poured into a lime mould, and preserved in a well-stoppered bottle under boiled water or very dilute acetic acid.

The ingots of thallium purified by the various methods above described were kept separate, and were employed in the synthetical operations described further on.

(To be continued.)

EXHIBITION OF APPLIANCES FOR THE PRODUCTION AND ECONOMICAL USE OF FUEL, IN CONNECTION WITH THE SOCIETY FOR THE PROMOTION OF SCIENTIFIC INDUSTRY, MANCHESTER.

(Concluded from page 89).

THERE is a very good show of various kinds of peat and patent fuel, with the necessary apparatus for condensing and purifying peat.

Kidd's process for carbonising peat consists of a large chamber or drying-room connected with a boiler which supplies superheated steam; from the boiler a steam-pipe passes through the furnace, and from thence into the flue; the steam, in its passage over the boiler-fire, becomes

* A spirit-flame is preferable to one of coal-gas, as the latter contains sulphur.

† The operation requires this peroxide of thallium to be constantly removed from the positive pole, or the passage of the current will be retarded and ultimately stopped.

super-heated, and, together with the smoke, passes into the drying-chamber; the peat, cut into pieces about the size of bricks, is put into a framework which runs upon wheels, so that it easily runs into the drying chamber, and is run out again when finished, thus saving a great deal of labour. The object of Kidd's process is the collection of the heated gases referred to in a closed chamber, where they may be usefully employed in charring peat, or converting it into charcoal; an artificial draught is created by jets of superheated steam, and the whole products of combustion from the furnace are forced into and retained by the closed chamber. The chamber is filled with peat, which may be dried and charred in less than forty-eight hours by the action of the furnace gases and superheated steam; the temperature of the chamber soon rises to between 300° and 400° F., and remains at some temperature between those limits. By charring the peat at a low temperature the loss of hydrocarbons is very small, the gases which are poured into the chamber being for the most part non-supporters of combustion; consequently it is impossible for the peat to take fire during the process of charring. The fuel used in the furnace which supplies the gases and generates the steam is peat, which has been partially dried in the open air. It is estimated that a ton of peat charcoal can be produced by this method at a cost of 13s. 6d., which sum includes all charges for interest on capital, royalties, and labour; raw peat at 3s. a ton; that used for fuel, 4s. 6d. per ton. Peat thus prepared produces a gas of high illuminating power, ranging between 20 and 22 candles, and 6000 and 9000 feet per ton; the gas is generated so quickly that three charges of peat can be worked off to one of coal, thus effecting considerable economy in the plant of gas works. The charcoal which remains after the gas has been extracted is also much more valuable than the ordinary coal-gas coke. There is, no doubt, a large field open for commercial enterprise in the manufacture of peat charcoal, owing to its freedom from sulphur and its affinity for oxygen at a high temperature. It is equal to ordinary charcoal for refining iron, steel, and other metals. In France, this charcoal, under the name of *carbon roux*, is largely used in the manufacture of gunpowder; it has been used as a fertiliser also for filtering water and town sewage, and when combined with a proper admixture of phosphate of lime it has been found useful as a substitute for animal charcoal.

Henry Clayton and Son show some fine machinery for preparing and forming blocks of condensed peat. One of the difficulties in preparing peat for the market is to get rid of the large amount of water which it contains, as sometimes it is met with containing from 55 to 80 per cent. Of this, a variable proportion is "loose, or free water," much of which, when present in the larger quantity, can be extracted by means of drainage and squeezing; the great bulk, however, of the water is "locked up," confined in the rooty, or fibrous portion of the peat. So retentive is peat of this fixed water, that no pressure, however powerful, can effect its expulsion while the peat remains in its natural condition. The objects which the Messrs. Clayton aim at are:—To get rid of as much water as possible by draining and squeezing, then to thoroughly cut up the fibrous or rooty portion, releasing the great quantity of water and air which was previously fast in the fibre, and reducing the whole to a uniform state of pulp. Peat thus prepared will freely and rapidly part with its moisture by natural evaporation, and in so doing will consolidate itself, and thus acquire a density which no pressure of the peat in its natural state could produce, becoming very hard and compact, and of a specific gravity nearly equal to coal; in this state it is (unlike the common prepared turfs) non-absorbent of water. The patentees of the condensed peat say that it produces little or no smoke, contains no sulphur, ignites more readily, and diffuses the heat more generally and more widely, than coal itself; leaves no cinder and but little ash. To accomplish these

objects with peat direct from the bog, the peat is filled (as dug) into squeezing-trucks, and during its conveyance from the bog to the machine much of the "free water" is pressed from the raw peat by a simple and easy means. From the trucks the peat is discharged into the machine, which, in its action, continuously cuts up minutely the fibrous portions of the peat, and produces a perfect admixture of the cut up fibre and rooty matter with the pulpy portion, thereby utilising the whole mass of the bog and entirely destroying its original character and natural spongy nature. In its travel through the machine the material further undergoes a moderate amount of pressure, and acquires a density and form permitting it to be discharged and deposited upon portable trays in blocks or briquettes of convenient size, and thence conveyed by a simple and labour-saving contrivance to the drying-sheds, where, after three weeks' drying (during average weather), the prepared peat becomes hard, compact, marketable fuel. A trial of condensed peat was made some time since for railway engines on the Belfast and Northern Counties Railway, with a view of testing its qualities as a fuel for locomotives. The engineers who made the trial say: "In order carefully to watch the power of the fuel in the generation of steam, we rode on the engine from Carrick Junction to Ballymena, a distance of twenty-seven miles. The pressure at starting was 100 lbs. on the square inch; the commencement of the journey was up an incline of about 1 in 80, 4 miles long, and with double curves. While going up the incline the pressure rose to 110 lbs., and afterwards to 120; the speed, whenever this was permitted, was 40 miles per hour."

Particulars of the above Locomotive Trial of Condensed Peat Fuel.

Total quantity of fuel used	14 cwts. 1 qr. 14 lbs.
Weight of train, including engine and tender	70 tons.
Number of carriages	Seven.
Miles run	74.
Time running	3 hrs. 9 mins.
Weight per mile used of peat fuel	21'47 lbs.
Average pounds per mile for the last three months, using Welsh and Scotch coals at a ratio of 2 of Welsh to 1 of Scotch.. ..	25'25 lbs.
Average for the month of May last	26'29 lbs.

The engineers conclude their report by saying:—"Having carefully noted all these facts, we have no hesitation in saying that we consider the condensed peat in every way well adapted as fuel for locomotive purposes."

A series of experiments have been made at the Commercial Gas Works, London, on condensed peat, the results of which are given below:—

Yield of One Ton of Coal.

Description of Coal.	Cubic feet of Gas.	Illuminating power in Sperm Candles.	Cwts. of Coke.	Gas per ton, equal to lbs. of Sperm.	Sperm corresponding to Gas of Boghead Cannel No. 2, equals 100.
Staffordshire	7,100	12'42	13'5	302	13'6
Derbyshire	7,600	11'71	17	395	13'7
Lochgelly	8,000	18'00	13	494	22'2
Derbyshire Cannel.. ..	8,500	20'60	15	600	27'0
Wigan Cannel.. ..	10,000	20'00	13'25	686	30'9
Newcastle Cannel.. ..	9,800	25'00	13'25	840	37'8
Lesmahago Cannel	10,500	40'00	10	1,440	64'8
Boghead (No. 1)	12,500	40'00	8	1,713	77'1
" (No. 2)	13,000	48'00	6	2,222	100'0

Yield of One Ton of Condensed Peat.

Belfast	10,500	15'65	8	562	25'3
Creavelea	9,240	18'75	8'75	594	26'7
Welsh	11,000	22'50	7	849	38'2

The following, extracted from a tabulated statement giving details of the various peat enterprises actually now working, will afford some interesting information on peat manufacture:—

System.	Where Working.	Horse-Power.	Tons of Dry Fuel per Machine per Season.	Cost per Ton.	Relative Value of to Coal.
Hodge's Canadian Peat Company.	Montreal, for Grand Trunk Railway.	16	4000	6s. 6d.	{ 5-6ths, or 84 p. ct.
Boston Peat Company.	New England States.	12	4200	8s.	84 p. ct.
Roberts, Pekin.	New York.	13	3500	8s. to 9s.	84 p. ct.
Haspalmoor. Colbermoor.	Bavarian Government Works.	Not stated.	Not stated.	12s.	60 p. ct.
Box's.	On trial.	16	{ Not stated.	Stated 4s. 8d.	—
Clayton and Son.	Gt. Britain and Germany.	6	3500	{ 3s. 6d. to 5s.	Variable according to quality of peat.

From the foregoing it will be seen that peat fuel possesses a calorific power of five-sixths of coal, and can be produced in Canada and the United States at from 6s. 6d. to 9s. per ton, where wages for labour are not lower than 7s. per day.

The Peat Coal and Charcoal Company make a show of peat in all its stages, from the time it is taken from the bog to the time it is compressed and carved, for they have some pieces which have been cut into flowers and fruit, till it looks like carved ebony. This Company has bought the patent rights of M. Challeton de Brughat; his process consists in making peat coal having nearly the same density as pit coal, and also he claims to have invented a better method of preparing peat charcoal. The cost of this peat coal at the manufactories may be taken at 8s. per ton for small quantities, and 6s. to 6s. 6d. for large quantities. 1½ tons of peat coal made by this process is reckoned to be equal to 1 ton of best English coal; for stowage it will only take, on an average, 20 per cent more room than ordinary coal. This Company intend to establish their first manufactory on the borders of North Wales and Shropshire. The peat on this land is of the best quality, averaging in depth about 12 feet. A trial of this peat was made on the Thames, on board the paddle-steamer *Times*, in the presence of the Duke of Sutherland and a distinguished company. The steamer ran from Beckton gas works to Greenwich in twenty-five minutes with a strong head wind, slack water at top of tide; and the quantity of uncompressed peat fuel consumed in this twenty-five minutes' run was about 210 lbs., maintaining a steady steam pressure of 50 lbs. without smoke, and at all times a good clear fire. The experimenters state that for the generation of steam it requires but a very moderate current of air, is absolutely smokeless, and gets up steam equally quick as coal, and maintains it with a less expenditure of fuel, does not injure the fire-bars, and is in every respect much cleaner than coal or coke.

The South of Scotland Peat Fuel Company exhibit fine samples of peat, which have been analysed and reported upon by Mr. Heddle, Professor of Chemistry in the University of St. Andrews.

The composition of the dried fuel, on analysis by combustion, is—

Gas	.. .. .	60.293
Carbon, free	.. .. .	31.064
Ash	.. .. .	8.643

In its ordinary condition, however, it contains—

Water	.. .. .	16.740
Gas	.. .. .	50.200
Carbon	.. .. .	25.864
Ash	.. .. .	7.196

It was found that a sample kept for some days under cover contained 16.4 per cent of moisture, and that samples artificially dried regained upon exposure nearly the above amount, so that it may be held to be impracticable to improve the fuel in this respect: the fuel yields gas at the rate of 7984 cubic feet per ton. When examined by

Lewis Thompson's fuel test-apparatus, the calorific power of the fuel was found to be—

In its usual state .. 4.675

When dried 5.940

That is, one part of the fuel will boil off as steam above 4½ times its own weight of water from 212°, and the dry fuel about 6 times its own weight.

A. C. Pelly shows his patent peat fuel, which he condenses into solid balls, of the density of hard wood: the peat balls, when manufactured ready for use, cost only about 5s. 6d. to 6s. per ton.

Prof. Reynolds reports upon the process, which consists in pulping the raw peat in a horizontal cylinder, within which a shaft carrying a number of arms is made to rotate rapidly, by steam or other power. The fibre is not only broken in this machine, but, owing to a screw-like action of the shaft, the peat pulp is forced through a circular opening, and then appears as a cylinder of pasty material, which is cut into short sections by very simple apparatus: the short cylinders of pulp so obtained fall immediately into a truncated cone, revolving rapidly. Here each piece is made to assume a rough spherical form: these pieces are then dried. The dry product of these simple operations appears in the form of irregular balls; hence the term ball-peat. The following is Prof. Reynolds's analysis of two samples of ball-peat:—

Hydrostatic moisture	.. .. .	15.12	14.87
Carbon	.. .. .	46.95	47.22
Hydrogen	.. .. .	5.01	5.14
Oxygen	.. .. .	29.83	31.22
Nitrogen	.. .. .	0.38	0.74
Ash	.. .. .	2.71	0.81

Professor Reynolds says—It is well known that the heating effect practically obtained from ordinary rough turf rarely exceeds 40 per cent of that afforded by Staffordshire coal: this ball-peat possesses a heating value equivalent to 55 per cent of that of the class of coal mentioned, or, in other words, to produce the heating effect obtainable from 1 ton of average Staffordshire coal it is necessary to burn about 2½ tons of ordinary turf, while 1½ tons of ball-peat would give the same amount of heat.

Reuben and Israel Levy exhibit "Leigh's" Patent Phoenix Fuel, which consists of refuse from coal fires mixed with tar or pitch, and made into balls. We cannot see the economy of the process, as it leaves 75 per cent of ash: they claim the novelty of using the ashes *ad infinitum*.

Radeke's patent artificial fuel consists of small coal, bound together in blocks by the aid of silica, both in solution and in a powdered state.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 19, 1874.

Dr. ODLING, F.R.S., President, in the Chair.

THE names of the visitors having been announced, and the minutes of the previous meeting read and confirmed, Mr. Walter Hills was formally admitted as a Fellow of the Society.

The names read for the first time were those of Messrs. Edward Townley Hardman, Leslie Crassweller Hill, Thomas W. Shore, William Kellner, and Andrew Fuller Hargreaves.

For the third time—Messrs. John George Lyon, Francis J. W. Polglase, Magnus Ohren, Harry Grimshaw, William Carleton Williams, Herbert Green, Henry Tanner, Colonel William Boyle, Thomas Carnelly, B.Sc., and Alexander H. Sexton, who were then ballotted for and duly elected.

The PRESIDENT then called on Mr. J. BELL, of the Laboratory, Somerset House, to deliver his lecture on

"The Detection of Adulteration in Articles of Food and Drink."

The lecturer commenced by some preliminary remarks on the fiscal regulations with regard to adulteration. As early as 1777, an Act of Parliament was passed to prevent the adulteration of tea, and in the following year another directed against the adulteration of tea and coffee. In the prosecutions instituted by the excise, however, every facility is afforded to the accused to defend himself, by allowing him to have portions of the same sample as that analysed at Somerset House for analysis and examination by his own chemist, and in all cases taken into court the analyst has to give his evidence on oath, and the defendant is finally dealt with according to the circumstances of the case.

As the cheapness of many of the starches causes them to be largely used for adulteration, one of the first things necessary in studying the subject is to become acquainted with the microscopic characters of the various starches, such as those of wheat, barley, oats, rye, maize, sago, rice, potatoes, beans, peas, &c. The speaker pointed out the distinctive characters of these, illustrating his description by well executed drawings of the appearance which the different varieties of granules present under the microscope. He also noticed the various kinds of arrowroot occurring in commerce, namely—that of the *Maranta arundinaceæ*; the East Indian or Curcuma arrowroot, from *Curcuma angustifolia*; the Tacca arrowroot, from *Tacca oceanica*; Cassava or Tapioca, from *Manihot utilisima*; the Portland arrowroot, from the tubers of *Arum maculatum*; and the Canna or Tous-les-Mois, from the *Canna edulis*.

The next subject treated was the adulteration of coffee, which can only be successfully accomplished after it is roasted and ground, but has, perhaps, been carried to as great an extent as almost any other article of food. A very simple way of detecting the presence of chicory in coffee is to sprinkle a little of it on the surface of water in a test-tube or wine-glass, when each particle of chicory becomes surrounded with an amber-coloured cloud, which spreads in streaks through the water until the whole acquires a brownish tinge; with pure coffee, however, no cloud is produced until the lapse of about a quarter of an hour. Another method of detecting adulteration is by the depth of colour obtained by the infusion of a given weight of the suspected article in water, and by the density of the infusion. The use of the microscope is, however, indispensable, and for this purpose it is necessary to be acquainted with the microscopic characters of the various substances used to adulterate the coffee, such as chicory, mangold wurzel, carrots, parsnips, turnips, beans, peas, acorns, locust-beans, rye, the husks of mustard-seeds, &c. The distinctive characters of these were described by the lecturer, and illustrated by enlarged drawings. He also noticed that the ash of coffee, remarkable as it is for the minute quantity of silica it contains, and for the absence of soda, afforded a valuable indication of its purity.

Tea is adulterated to a very large extent, not only with leaves of various kinds, including exhausted tea-leaves, but also with inorganic substances, such as quartz, sand, and magnetic oxide of iron; these latter substances are rolled up inside the leaf, and one sample of green tea examined was found to contain no less than 20 per cent of quartz and 8.6 of the magnetic oxide. The latter may readily be separated by grinding up the tea, and removing the magnetic oxide with a magnet. The facing employed for green tea usually consists of French chalk and Prussian blue. In the preparation of exhausted tea-leaves, they are rolled up with gum-water, and then dried, catechu being added in some cases to restore the astringency. The article known as the "maloo mixture" consists essentially of exhausted tea-leaves. In searching for the presence of other leaves than those of the tea-plant, the best method is to heat a small quantity of the suspected tea with water until the leaves are sufficiently softened to admit of being unfolded. They should then be spread out on a piece of

glass, and carefully examined as to the nature of the serratures and the character of the venation, also the form of the cells of the epidermis and the stomata, and the peculiarities of the hairs as shown by the microscope. The essential differences which the tea-leaf presents when compared with other leaves were minutely described. The chemical composition of tea was next discussed, the amount of lignin and of tannin being very important.

The two kinds of pepper, known in commerce as black and white pepper, are derived from the same plant, but differ in the latter being bleached, or having the husk removed by washing; but neither kind can be adulterated with success before it is ground. The most common adulterants of ground pepper are linseed-meal, the husks of mustard-seeds, rice, bean- and pea-meal, and the flour and bran of the ordinary cereals, ground chilies being sometimes added to restore the pungency. Some of these substances can be readily detected by diffusing the pepper in water, and pouring the mixture on to a muslin sieve; the deep red particles of the chili can then be recognised, and also the camphor-like fragments of rice. The mustard-husks are known by their cup-like shape, whilst the smooth shining appearance of the linseed readily distinguishes it from the dull brown of the pepper.

The lecture was copiously illustrated by drawings of the structures of the various substances treated of, as exhibited under the microscope; but, from want of time, the lecturer was unable to say anything about the adulteration of cocoa, tobacco, or beer.

Dr. ODLING, in proposing a vote of thanks to the lecturer, said how greatly obliged they were to him for his discourse, illustrated as it was with so many admirable drawings of the microscopic structure of the various articles of food and of the substances used to adulterate them. It was a great privilege to be allowed to draw from the large store of valuable information he had accumulated, and hoped that it might be put in some permanent form for reference.

The lecturer, in replying to questions from Dr. Wright and Dr. Voelcker, said that the amount of ligneous matter in tea was determined by thoroughly exhausting the leaves by repeatedly boiling them with fresh quantities of water until the washings were colourless. He thought that the amount of theine in tea did not afford positive evidence as to whether it was adulterated or not, as the amount in the different qualities of tea varied from 1.8 to 5.9 per cent; the estimation of the tannin present was far more important.

The meeting finally adjourned until Thursday, March 5, when papers will be read—(1) "On the Condition of the Spontaneous Inflammability of Charcoal," by Mr. G. F. Hargreaves. (2) "Researches on the Action of the Copper-Zinc Couple on Organic Bodies; Part IV., On the Bromides of the Olefines," by Dr. J. H. Gladstone and Mr. A. Tribe. (3) "Action of Benzyl Chloride on Camphor; Part II.," by Dr. Donato Tommasi. (4) "Action of Trichloroacetyl Chloride on Urea," by Messrs. D. Tommasi and R. Meldola. (5) "On Sulphocyanide of Ammonium and Sulphocyanogen," by Dr. T. L. Phipson. (6) "Researches on the Action of the Copper-Zinc Couple on Organic Bodies; Part V., On Ethyl Bromide," by Dr. J. H. Gladstone and Mr. A. Tribe. (7) "On the Action of Hydrogen on Finely-Divided Metals, by Mr. A. Tribe.

Erratum.—In our report of the meeting of the Society on Feb. 5 (see p. 81), Dr. Odling's remarks on Dr. How's paper, that "the results were not new," only applies to "the varying amount of coke yielded by the coal in experiments on small quantities."

Society of Arts.—At the first meeting of the Chemical Section of this Society, Mr. Frederick Field, F.R.S., will read a paper "On the Paraffin Industry." Dr. Odling, F.R.S., will preside, and, as this is the opening meeting of the Section, he has undertaken to give a short address upon "The Importance of Industrial Chemistry."

CORRESPONDENCE.

DETECTION AND ESTIMATION OF ALUM IN FLOUR AND BREAD.

To the Editor of the Chemical News.

SIR,—Through the medium of your valuable paper I shall be glad to offer a few remarks on the above subject, with special reference to a method devised and recommended by Mr. Wanklyn. Suffice it for me to mention here that it is an incineration process aided by oxygen, employing not less than 150 or 200 grms. of bread. I say so far so good, and, indeed, further, for I think that all analytical chemists will agree that the use of the smallest *adequate* quantities of reagents is always preferable and safest in all analytical operations, especially of a quantitative character, which is what Mr. Wanklyn aims at by the method referred to, in recommending a certain measured quantity of hydric sulphate and weighed quantities of the other chemicals required. So that the soundness of the principle involved is beyond dispute; and, indeed, when I first perused the instructions I looked upon the whole process with much favour, but upon further consideration in its application to bread (not flour) I conceived a weak point, which experiments purposely directed have proved to be so. We are all aware that bread contains some sodic chloride, which of course is left with the ash, so that when the residue is treated with concentrated hydric sulphate, as recommended, copious fumes of hydric chloride are evolved; heat has now to be applied till sulphuric fumes begin to rise. Thus I imagined some aluminic chloride may escape, and my experiments with alumised bread (2 grms. alum to the 4-lb. loaf) have clearly proved it to be so; for I have been unable to get the slightest indication of alumina in the several experiments I have conducted according to Mr. Wanklyn's method, except that rather more of the reagents than recommended were found requisite; the residue from the same bread has yielded alumina by treatment with hydric chloride, &c., in all of the several cases tried.—I am, &c.,

E. W. T. JONES, F.C.S.
County and Borough Analyst.

10, Victoria St., Wolverhampton,
February 18, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, January 5, 1874.

Conductibility of Magnetic Tensions.—M. Jamin.—The expression *coercitive force* has been used to denote the difficulty of magnetising iron or steel, and the resistance opposed to the causes of demagnetisation. This is somewhat vague M. Jamin says. Suppose an iron bar brought near to, say, the austral end of an electro-magnetised bar. The former takes boreal magnetism at its nearest end, austral at its furthest. There is a mean line always between the middle and the core. It nears this core as the bar nears it, and finally disappears when the bar comes into contact with the core. Then the boreal tension is wholly concentrated at the face of contact, concealed by an equal magnetism accumulated in the core. There remains only austral tension prolonged from the core to all points of the bar. Here note two essential things:—1. The tension is always the same on the two sides of the face of contact; on one hand in the core, on the other in the bar; there is magnetic equilibrium without a difference, a fall between the two metals. 2. The

austral tension continues along the bar to its free end almost without diminution of intensity, if the bar do not exceed 85 centimetres. Thus soft iron has the double property of becoming in equilibrium of tension with a magnet which it touches, and of propagating this tension through its substance to great distances. This is its essential character, which may be expressed by saying that it is a *good conductor of magnetic tensions*. Steel, again, has a small conductivity for magnetic tensions.

Mechanical Interpretation of the Laws of Dulong and Petit, and of Woestyn on Atomic Specific Heats (apropos of Recent Observations by MM. Lockyer, Dumas, and Berthelot).—M. Ledieu.—The author concludes—(1). That, according to Dulong and Petit's law (corrected), the mean vibratory *vis viva* of the atoms in absolute simple bodies, with a given temperature, is the same; and, *vice versa*, the law follows from this equality. (2). The hypothesis of constancy of said force, whether the atoms form part of a simple or compound body, has, for direct corollary, Woestyn's law (corrected). (3). Add the supposition that the bodies hitherto thought simple may be decomposable into other primary elements under very high temperatures, and we have an interesting interpretation of the equality of absolute atomic specific heats of substances hitherto thought simple, viz., the molecules of these substances, representing their actual atom, may be composed of an equal number of primary atoms having the same mass or not.

Ascent of the Balloon "Jules Favre" in Southern Russia.—M. de Fonvielle.—M. Bunella went up in this balloon from Karkoff on Nov. 2, at 3.30 p.m., and the voyage lasted till midnight; during which the balloon was carried only 190 kils. in horizontal direction, and reached a maximum height of 2700 metres; this after sunset. The motion of the air was more rapid near the ground than high up. The velocity of translation was measured by watching the progress of the balloon's shadow, thrown by the moon, on the ground. At sunset, after passing through an abundant rain in a cloud, M. Bunelle found a magnificent sky and agreeable temperature, the air moving from the south and being warmer than that near the ground. After 5 p.m., several falling stars were seen, and it afterwards appeared they had not been visible from the ground.

Letter on Relations between the Sun-Spots, Earthquakes in the Antilles and Mexico, and Volcanic Eruptions over the Entire Globe.—M. Poëy.—The writer gives a table with 786 volcanic eruptions, throughout the surface of the globe, from 1749 to 1862. The maxima of eruptions correspond to the minima of solar spots, and the minima to the maxima of spots. The table also gives a list of 38 *seismic tempests* in Antilles and extending to America, &c.—meaning, by the expression, periods of convulsion more or less intense. Of the 38, 17 correspond to maxima of solar spots, and 17 to minima. There are four others—1846, 1851, 1852, and 1853,—found at equal distances between the maxima and the minima of spots.

Reply to Remarks of M. Faye on Terrestrial and Solar Cyclones.—M. Th. Reye.—M. Faye (the writer says) does not answer the following questions as to the "machine" he represents the *trombe* to be:—Why it acts almost exclusively in summer and heat (especially on burning deserts), also when the air is calm; why the atmospheric pressure is diminished at its base, instead of increased; why dust and light objects rise into its interior; why uprooted trees and like objects are found afterwards lying in directions converging towards the base of the *trombe*. All these effects are against M. Faye's theory. [M. Faye made some remarks in reply to this communication].

Variable Period at Closure of the Voltaic Current—M. Cazin.—Reply to M. Blaserna.

Pluvial Régime of the Torrid Zone in the Basin of the Atlantic Ocean.—M. Raulin.—The author previously

showed that in France most rain falls in the interior during the hot months, and in the littoral regions during the cold. He finds analogous differences, much more pronounced, in the torrid zone, and he shows this by tables of rainfall. In the basin of the Atlantic, *e.g.*, there is complete opposition in the west, in America, between Mexico, Central America, Venezuela, and the Antilles, on the north, and New Grenada, the Guyanas, and Brazil, on the south; and in the east, in Africa, between Senegambia and the Cape Verd islands, on the north, and Guinea and the islands of Ascension and Saint Helena on the south.

Conditions of the Formation of Octahedral Borax.—M. D. Gernez.—It is known that borax forms two hydrates—the one containing 5 equivalents of water, and crystallising in regular octahedrons; the other containing 10 equivalents, and forming oblique rhombic prisms. The octahedral crystals are commonly considered stable only at relatively high temperatures. The author, however, finds that both the prismatic and the octahedral form can be produced at low temperatures. The temperature of 56°, which has been indicated as the inferior limit for the production of prismatic borax, is in reality only a temperature near the higher limit at which the production of prismatic borax has been observed, since this salt loses a part of its water at this temperature.

Absorption of Dry Ammoniacal Gas by Cane-Sugar.—M. E. Laborde.—On employing absolutely dry sugar, and submitting it to the action of a current of ammoniacal gas, dried over a long column of quick-lime, the sugar becomes at first opalescent, and takes the waxy consistence described by Raspail, but in the course of twelve hours it liquefies, and flows on the surface of the tube in which it is contained; 100 parts of sugar absorb 7.83 of ammonia. On exposure to the air, the sugar loses the ammonia which it had absorbed. At the end of three months, the sugar retains only about 0.37 per cent, and has still a very pungent flavour. Glucose, similarly treated, liquefies very rapidly, becoming coloured, and forming a crystalline product.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin,
No. 18, December 8, 1873.

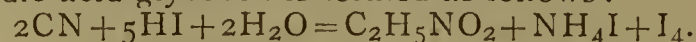
Influence of Temperature upon the Chemical Development of Heat.—Julius Thomsen.—A physico-mathematical paper. The author shows that the influence of temperature upon the chemical development of heat is very considerable when the process occurs in the moist way, and that consequently all results of thermo-chemical determinations in the moist way are valid only at the temperature of the specific experiment.

The Magic Lantern as a Means of Illustrating Chemico-Physical Lectures.—Hermann Vogel.

Method of Determining Anthracen.—E. Luck.—The author dissolves 1 grm. of the sample of commercial alizarin in question in 45 c.c. glacial acetic acid at the boiling-point in a small flask. The solution, if needful, is filtered whilst boiling, and a solution of 10 grms. of chromic acid in 5 c.c. of water and 5 c.c. of glacial acetic acid is gradually added, the liquid being kept gently boiling. The addition of this mixture is continued till a distinct and permanent yellowish-green colour appears, or till after prolonged boiling a drop of the liquid, placed upon a clean silver coin, produces a reddish spot (chromate of silver). The whole is then allowed to cool, gradually diluted with 150 c.c. of water, filtered after standing for some hours, the chinon is washed upon the filter, first with water, and then with hot very dilute potassa lye, then again with water, dried at 100° C., and weighed. After weighing the chinon is removed from the filter, and the latter is weighed again. Thus the nett weight of the anthrachinon is obtained, to which 0.010 grm. must be added, that quantity having been dissolved and removed by the above-directed quantity of glacial acetic acid and water. Commercial chromic acid often contains lead.

Reaction with Formiate of Soda.—V. von Richter.—A reply to V. Meyer's paper.

A New Synthesis of Glycocol.—A. Emmerling.—If cyanogen gas is treated at a boiling heat with concentrated hydriodic acid glycocol is formed as follows:—



Nature of the Elements.—J. A. Groshans.—A continuation of the author's former papers on the same subject. It is not suited for abstraction.

Preparation of Meta-Toluidin from Commercial Aniline.—L. Schad.—The author operates upon aniline of the following boiling-points:—

196°	.. .. .	27 per cent.
198°	.. .. .	60 "
200°	.. .. .	77 "
202°	.. .. .	85 "
204°	.. .. .	90 "

10 lbs. of this aniline are converted into nitrate with nitric acid of sp. gr. 1.2. The hot liquid is stirred till cold, the crystalline powder is filtered off and strongly pressed. The pressed cake is dissolved in so much boiling water that the hot solution stands at sp. gr. 1.1. It is then stirred till cold, filtered, and the crystals pressed again. These are then dissolved in so much boiling water that the solution marks 1.075. It is then stirred till cold, filtered, and the crystals pressed again. It is again dissolved in boiling water to sp. gr. 1.05, stirred till cold, filtered, and the crystals pressed once more. The mass thus obtained yields, on decomposition with caustic soda and rectification, an oil which is contaminated only with bases boiling at higher temperatures. To remove the latter the oil is converted into chloride by means of hydrochloric acid of 20 per cent, stirred till cold, and the mother-liquor removed with the Bunsen filter-pump. The crystals are twice dissolved in a minimum of boiling water, stirred till cold, and the mother-liquor pumped away. After decomposing the last crop of crystals with caustic soda and rectifying, meta-toluidin is obtained with a constant boiling-point of 197°, and showing neither the reactions of aniline nor para-toluidin.

Phosphide of Antimony.—W. Ramsay. (A preliminary notice.)—R. W. E. Macivor, of the Andersonian University, Glasgow, has succeeded in forming phosphide of antimony, PSb, as a red powder, insoluble in benzol, ether, and bisulphide of carbon, and containing—

Antimony	.. .. .	79.48
Phosphorus	.. .. .	20.21

99.69

Optical Properties of Certain Compounds of the Pentan Series.—M. Ley.—A lengthy paper, not suited for abstraction.

Addition of Cyanamid.—E. Baumann.—The author has obtained and examined alakreatinin, alakreatinin-chlorzinc, besides experimenting on the addition of substituted cyanamids, and on the behaviour of cyanamid with acids.

On Cholic Acid and the Protein Compounds.—F. Baumstark.—The author recognises in cholic acid that constituent of the albumenoid bodies which reacts with Pettenkofer's test.

Hexa-hydrois-oxylol.—F. Wreden.—A preliminary communication.

Chemistry at the Forty-Sixth Meeting of German Naturalists and Physicians at Wiesbaden.—Reported by Messrs. Flight, Mayer, Michaelis, and Oppenheim.—H. F. Weber read a paper on the specific heat of graphite and diamond, and of carbon in its combinations.

The President of the Chemical Section, Löwig, of Breslau, read some papers by Tollens, of Gottingen, on two isomeric bibrom-propionic acids, on an acid formed by boiling sugar with dilute sulphuric acid, and on the compounds of starch with potassa and soda.

Wibel explained his new water air-pump.

Horsford gave a communication on the reduction of carbonic acid to carbonic oxide by phosphate of iron. An ethereal solution of chlorophyll is resolved by hydrochloric acid into a blue and a green stratum. The first mentioned contains iron, lime, and phosphoric acid—the constituents of Vivianite. Zinc and sulphurous acid destroy the colour. Carbonic acid, enclosed with ferrous phosphate in a tube, is gradually decomposed, while the salt of iron turns blue. About one-sixth of the carbonic acid is, in a few days, converted into carbonic oxide.

Graebe and Caro communicated an interesting paper on the constitution of rosanilin. They ascribe to rosolic acid the formula $C_{20}H_{16}O_3$.

Oppenheim gave an account of his researches on the product of the reaction of oxide of mercury upon benzamid.

Lossen read a paper on amidic derivatives of hydroxylamin.

Scheibler exhibited two specimens of arabinose, $C_6H_{12}O_6$, a gum-sugar which he had recently described.

V. Meyer gave the results of his experiments on the action of formiate of soda upon sulpho-benzoic acid and benzoic acid. Wislicenus added a notice that the observations of Richter have no connection with Meyer's reaction. He also made a communication on ethylen-lactic acid.

In the second session, September 20, Meyer read a paper on the action of sulphuric acid upon nitro-ethan.

Wurston gave a short communication upon fulminic acid, for which he proposed the formula, $H(NO_2)C_2NH$.

Boettger called attention to some new interesting lecture experiments on active hydrogen and active oxygen.

Weith treated of desulphurising diphenyl-sulph-urea by oxide of mercury.

Petersen gave his opinion as to the chemical location of the benzol derivatives.

Fittig read a paper on chinons.

In the third session Himyl gave an account of Schorer's water air-pump.

P. Rasenach described a hydrocarbon obtained from the portion of coal-tar which boils at the highest temperature.

Michaelis exhibited his derivatives of phosphenyl-chloride.

Staedel described the reduction of benzophenon.

Blockmann reported on two analyses of coal-gas, before and after passing through porcelain tubes at 1000° . The hydrogen had increased, and all heavy hydrocarbons had disappeared.

Walter treated on the "changing valence" of nitrogen, phosphorus, &c.

Bauman gave a paper on the addition of cyanamid.

Staedel spoke on chlorinised ethans.

Gscheidlen exhibited an apparatus for mixing two solutions without access of air.

Thudicum contended against the accuracy of Strecker's formula for bilirubin, on the ground that hexatomic acids were unknown in organic chemistry.

Heumann pointed out certain uniformities in the melting-points of chlorinised azo compounds of benzol.

In the Section of Agricultural Chemistry, Wolff gave an account of the use of cockchafer as food for pigs. The chitin was (as might be expected) found quite indigestible.

A. Mayer gave an account of some important experiments undertaken to decide as to the power of absorbing ammonia—gaseous or in aqueous solution—possessed by the parts of plants *above* the surface of the ground. A variety of plants examined were found to possess this power, but, at least under the circumstances observed, a normal growth of plants seems impossible if the introduction of nitrogen through the roots be excluded. The *leguminosæ* have, in these experiments, shown no especial power of absorbing ammonia by their leaves and stalks, or of assimilating the trace of combined ammonia present in the atmosphere.

Kreusler reported on the accuracy of Will and Varren-trap's method of determining nitrogen in albuminates. In accordance with Maecker and Petersen, but in contra-

dition to Seegar and Nowak, he found the soda-lime process trustworthy, even in case of albuminates. He pointed out that the soda-lime of commerce is often contaminated with nitrates and nitrites.

Fleischer gave results on the respiration of sheep.

Wildt gave an account of experiments on the secretion of hippuric acid. He considers that the cuticular substance of the vegetables consumed furnished the hippuric acid. Rabbits fed on pure grass yielded a trace of hippuric acid; if fed on clover, but little; but if allowed to eat dandelion a considerable quantity.

Neubauer and Canstein discoursed on the movement of sap in the vine, and on the qualitative composition of this liquid.

Mayer gave statistics on the results of manures.

Wolff spoke on water cultivation, and on the influence of different doses of phosphoric acid upon the development of the oat plant.

In the Mineralogical Section Flight described his experiments on the colours of the diamond. A rose-coloured diamond of 29 carats, exhibited at Paris in 1867 by Coster, of Amsterdam, was bleached in four minutes on exposure to diffused light, but resumed its colour when heated in asbestos, and retained it if preserved from daylight. Two dull yellow diamonds from the Vaal river were selected, one of which was preserved for comparison, while the other was subjected to modifying experiments. On being heated to redness in a current of hydrogen, it was found colourless when cold, but gradually assumed its colour on exposure to daylight. If heated in a current of chlorine the result was the same.

Flight gave an account of the "distillation method" for the determination of silicic acid as developed by himself and N. Story-Maskelyne. The description of the apparatus requires a diagram.

Flight gave last an account of the experiments of Douglas, Hermann, and Story-Maskelyne on the crystallisation of phosphorus.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 5, January 29.

Gypsum and Salt in Agriculture.—Pierre Deschamps.—The author has experimented on the use of sulphate of lime with the addition of common salt as a manure for winter tares. Salt water, as is well known, dissolves a much larger proportion of gypsum than pure water. The yield was—

	Grain. Kils.	Straw. Kils.
4 hectolitres gypsum per hectare ..	962	2400
4 hectolitres gypsum and 60 kilos. of salt	1324	4100
2 hectolitres gypsum and 200 kilos. nitrate of potash	1600	3300

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in gas-lamp blow-pipe apparatus, part of such improvements being applicable to other oil and spirit lamps. John Robert Harper, Clerkenwell, Middlesex. April 4, 1873.—No. 1251. The first part of these improvements has for its object the combination of a current of air with the jet of ignited gas or vapour as it issues from the oil or spirit vessel and jet-pipe of such apparatus. The jet-pipe is surrounded by, or enclosed within, another pipe, open at each end, so that, when the jet of gas or vapour is ignited, a strong current of air is caused to enter the pipe behind the jet of ignited gas, with which it combines, thereby increasing the intensity of the flame so produced. By reason of this improved arrangement, the flame of an auxiliary lamp can be dispensed with. According to another part of these improvements, an additional jet-pipe (or pipes) is employed to evaporate and maintain the pressure in the oil or spirit vessel, in place of the auxiliary lamp heretofore employed for this purpose. According to another part of these improvements, the oil or spirit vessel is surrounded with a water- or steam-jacket, to which heat is applied for transmitting heat to the oil or spirit vessel for producing the gas which supplies the jet or jets of the blowpipe apparatus. Another part of these improvements relates to the arrangement and construction of the safety-valves of such apparatus. The safety-valve is surrounded with a case to

receive the gas when it escapes through the safety-valve and conduct it to the jet-tube, where it is consumed with the gas from the jet. In accordance with another part of these improvements, the oil or spirit vessel is formed with a chamber or passage through which the gas-jet and safety-valve tubes are conducted in order to afford ready access to the gas-cocks and apparatus. According to another part of these improvements, gas blowpipe apparatus when out of use is enclosed in a central chamber formed within an annular-chambered oil or spirit can or vessel containing a supply of benzoline, paraffin, or other cheap oil or spirit, thereby rendering the apparatus more convenient and portable. When auxiliary lamps are employed, a benzoline, paraffin, or other similar lamp is used in place of spirits of wine, as heretofore.

A new colouring matter or "dye." Alexander Melville Clark, patent agent, 53, Chancery Lane, Middlesex. (A communication from Emile Digeon and George Goldsmith, both of Paris, France). April 10, 1873.—No. 1331. This invention relates to the preparation of a yellow colouring matter from the roots of the asphodel (a plant of the order Liliaceæ). The colour is obtained by decoction, or preferably by extracting the juice by any known means. By dipping fabrics dyed with this yellow in an alkaline bath, shades of maroon may be obtained.

Improvements in the preservation of alimentary substances, and in apparatus for the same. Alexander Melville Clark, patent agent, 53, Chancery Lane, Middlesex. (A communication from Bernard Delrieu and Jean Marie Pernoud and Co., of Lyons, France). April 16, 1873.—No. 1370. This invention is based on the desiccation of alimentary substances *in vacuo*, in the presence of hygrometric matters capable of absorbing the vapours of water as they form, preferably sulphuric acid at from 48° to 52° Baumé. The desiccating apparatus consist of a series of boxes, and of two series of air-pumps, one for producing a vacuum in each box, and the other for acting on the whole of the boxes. Each desiccating box is divided vertically into two equal parts, each half containing rows of leaden trays for the acid, and of frames for the matters under treatment, disposed alternately, to avoid congelation.

A new or improved composition for treating, impregnating, and coating wood, so as to preserve and render it impervious to water and other fluids. William Hockley, 26, Bloomsbury Square, Middlesex. April 16, 1873.—No. 1382. This invention has for its object the preparation of a composition for treating, impregnating, and coating wood so as to render it impervious to water and other fluids, being particularly applicable for treating and impregnating the interior of casks, vats, or other hollow vessels made of wood, to render them impervious to the action of the malt liquor or other fluids they are required to contain. For this purpose what is generally known as paraffin wax is employed, purified, and refined by boiling. To this gum anemie and gum galguminum are added, in the proportions of about 1 ounce each to 7 lbs. of paraffin. About the same proportion of gum copal may be combined with the above ingredients for some purposes, if desired.

NOTES AND QUERIES.

Linseed Oil.—Having considerable difficulty in procuring pure linseed oil, I would like to ask through your journal for a means of separation, the adulteration being cotton-seed oil.—F. P. C.

Coal Brasses.—Will some of your readers inform me whether coal brasses are used alone for the manufacture of sulphuric acid, or must they be mixed with other pyrites? Will the ordinary pyrites burner answer, and is the sulphuric acid very brown?—K.

MEETINGS FOR THE WEEK.

- MONDAY, March 2.—Medical, 8.
 — Society of Arts, 8. Dr. Graham, "On the Beer of the Future."
 — Royal Institution, 2. General Monthly Meeting.
 — London Institution, 4.
- TUESDAY, 3.—Royal Institution, 3. Prof. Tyndall, "On the Physical Properties of Liquids and Gases."
 — Civil Engineers, 8.
 — Anthropological, 8.
 — Zoological, 8.30.
 — Society of Arts, 3. Consul Thomas J. Hutchinson, F.R.G.S., "On the General Features of West African Trade from Senegal to St. Paul de Loanda."
- WEDNESDAY, 4.—Society of Arts, 8. Mr. George Lund, "On Bells and Modern Improvements for Chiming and Carillons."
 — Microscopical, 8.
 — Pharmaceutical, 8.
- THURSDAY, 5.—Royal Institution, 3. Prof. W. C. Williamson, "On Cryptogamic Vegetation (Ferns and Mosses)."
 — Chemical, 8.
 — Royal, 8.30.
 — Royal Society Club, 6.
- FRIDAY, 6.—Royal Institution, 8; Weekly Evening Meeting. Sir Samuel Baker, M.A., "Suppression of the Slave Trade of the White Nile," 9.
 — Geologists' Association, 8.
 — Society of Arts, 8. F. Field, F.R.S., "On the Paraffin Industry."
- SATURDAY, 7.—Royal Institution, 3. Mr. R. Bosworth Smith, "On Mohammed and Mohammedanism."

TO CORRESPONDENTS.

A. E. S.—Our last Students' Number (No. 720, Sept. 12, 1873) would probably assist you in choosing a college.

F. A. V.—Your description is not of sufficient value to justify expense of woodcut.

A Subscriber.—Consult Crookes's "Select Methods in Chemical Analysis," published by Messrs. Longmans and Co.

J. I. Y.—A reply to your questions would necessitate a detailed chemical examination.

J. Wills.—Received with thanks.

Ganot's Two Works on Natural Philosophy, translated and edited with the Author's sanction by E. ATKINSON, Ph.D., F.C.S., Professor of Experimental Science, Staff College:—

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THE CHEMICAL NEWS.

VOL. XXIX. No. 745.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 97).

SECTION IV.—PROCESSES AND RESULTS.

THE processes and manipulation necessary to the determination of an atomic weight are at all times difficult and delicate, but especially so in the case of a metal such as thallium, so readily oxidisable. This strong tendency to combine with oxygen renders the ordinarily exact processes of weighing out pure metals inapplicable to the present purpose. The chances of contact with the oxygen of the atmosphere must be reduced to a minimum, and to this end the following modes of operation were devised. The method found to be the most accurate, and that adopted in repeating the determinations, will receive a description more detailed than the first, and what may be termed approximate, methods.

Process of the Conversion of Thallium into Nitrate of Thallium.

Thallium being a metal of very high atomic weight, the change in weight in the interconversion of its compounds is comparatively too small to be estimated with any approximation to accuracy. For instance, the conversion of acetate of thallium into chloride of thallium is an operation hardly to be effected without such loss as would seriously interfere with the calculated result.† The immediate conversion of the metal into one of its salts is therefore the method affording results less liable to be affected by errors in observation; and the conversion of thallium into its nitrate has been that ultimately adopted.

Pure thallium, obtained as described, is cut into small bars with a very sharp steel knife, and dropped into a dish of pure water slightly warmed, and forming the sub-stratum to an atmosphere of carbonic acid in a vessel large enough to admit both hands easily. In this bath the original surface of the ingot is removed and rejected. The bars are then well rubbed with fine cambric to smooth down all sharp edges. Any pieces which contain pores are rejected.‡

A stoppered tube (Fig. 11) is half filled with water, and weighed. The bars of thallium are then quickly removed from the warm water of the carbonic acid bath, rapidly wiped dry with warm cambric while in the carbonic acid, and put into the weighed tube of water. It is found that no appreciable oxidation takes place during this transference, and that the whole of the moisture can be removed. The tube and its contents are then weighed again.

Fig. 12 represents a vessel for the conversion of thallium into its nitrate, the pure metal as weighed in the manner described above in a tube of water being placed in the bulb *a*, and the pure nitric acid in *b*. The tubes are accurately ground, and fitted to each other at *c*. *d* is a permanent stopper to the upper bulb, well ground. *e* and *f* are platinum wires for the support of the flask in the balance. The process of converting the thallium into its nitrate coincides in detail with this apparatus with the process ultimately adopted, and particularly described in the succeeding pages. With an apparatus of this kind the determination A was performed, the metal being purified by the process already described under *a* (p. 96).

* A Paper read before the Royal Society June 20, 1872.

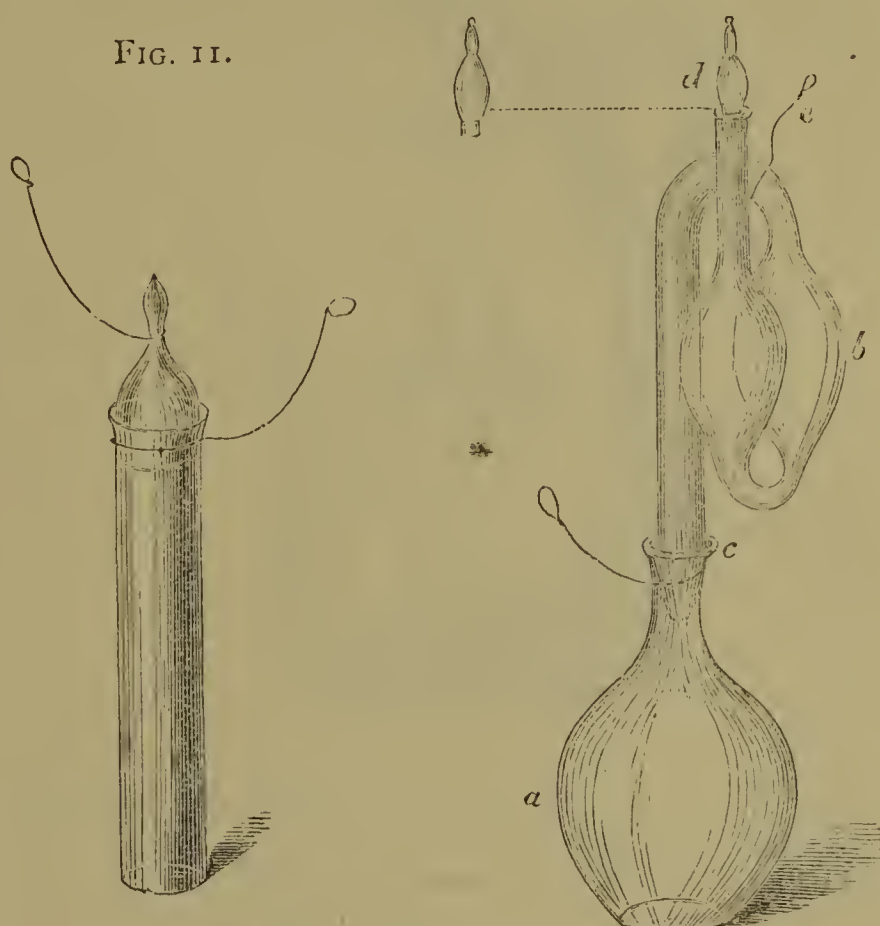
† An error of 0.05 grain in the weighing accumulates to an error of 0.95 in the atomic weight.

‡ The upper surface of the fused lump is full of pores for a depth of one-sixteenth of an inch; one-quarter inch is therefore removed for greater certainty.

Fig. 13 is a further improvement. The nitric acid, in acting upon the metal in *a*, evolves fumes, which mechanically carry off traces of nitrate of thallium. In the vessel shown in Fig. 12, these fumes are washed in the nitric acid, offering, however, no great advantage; but, in the series of bulbs shown in Fig. 13, *b* contains the nitric acid, which can, by means of the tap *c*, be admitted in the required quantity to the metal. The fumes are washed in the water contained in *g*, the water being evaporated to obtain the nitrate of thallium held in solution. In this apparatus, and with metal purified by the process described under the letter *a*, the determination B was effected. The metallic thallium is weighed sealed up in hydrogen in the following manner:—

The lump or ingot of pure metallic thallium prepared by the process *a*, already described, is cut up into parallelograms, all the original surface being removed with a

FIG. 12.

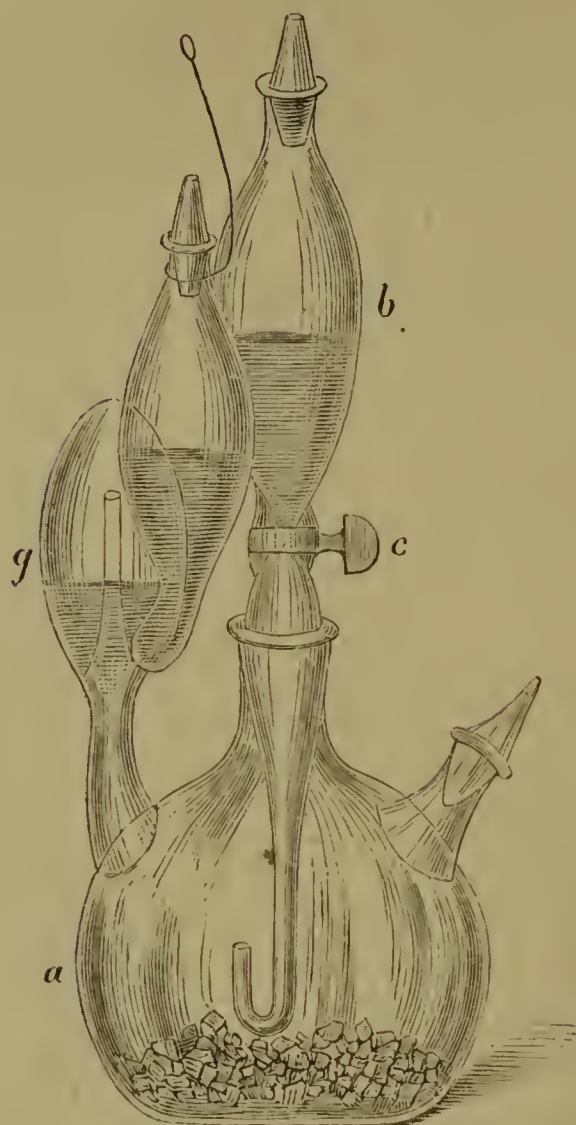


very sharp steel knife. The parallelograms, immersed and boiled in very dilute sulphuric and hydrochloric acids, are subsequently washed, boiled repeatedly in water, and then transferred to the glass tube *a*, Fig. 14. Into this tube pass and are fused the platinum wires, *b c*, these wires being the reducing and oxidising electrodes respectively in connection with two Grove's elements. At *d* the tube is drawn out to a fine orifice, and at *e* is passed in a current of pure hydrogen prepared as before described, as shown in Fig. 15. The electric current being passed through the water, to preserve the pure metallic surface of the thallium, heat is applied until the water is entirely volatilised. At this point, and while the tube is very hot, the dry hydrogen still passing, the end of the tube at *d* is sealed up, and then the tube at *h*, previously much contracted, is closed before the blowpipe. The metal is thus enclosed hermetically in an atmosphere of pure hydrogen. The tube and its contents are then cooled for six hours, and, when cooled, weighed first in air and then in the vacuum-balance. The tube is now cut across the middle with a cutting-diamond, wrapped up in smooth platinum-foil to secure any splinters of glass which might be thrown off, and then broken with a sharp blow opposite the cut. The thallium is carefully removed from the pieces of tube, and introduced into the apparatus where the subsequent operations are to take place. The pieces of tube, with any splinters which may have broken off, are weighed, first in air and then in a highly rarefied atmosphere. The difference between the weighings of the full and empty

tube, after correcting for the hydrogen contained at first, gives the weight of thallium taken.

These two forms of apparatus were found to answer the purpose tolerably well. Several improvements, however, suggested themselves whilst the determinations were in

FIG. 13.



progress, and they were finally embodied in the apparatus shown in Figs. 16, 17, and 18. In this several refinements of manipulation can be introduced which were impracticable with the former apparatus—notably, the ease with which a definite quantity of metal is introduced into the

FIG. 14.

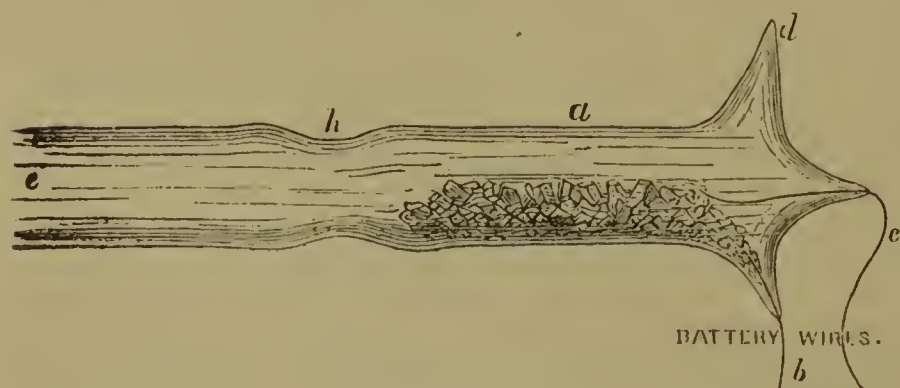
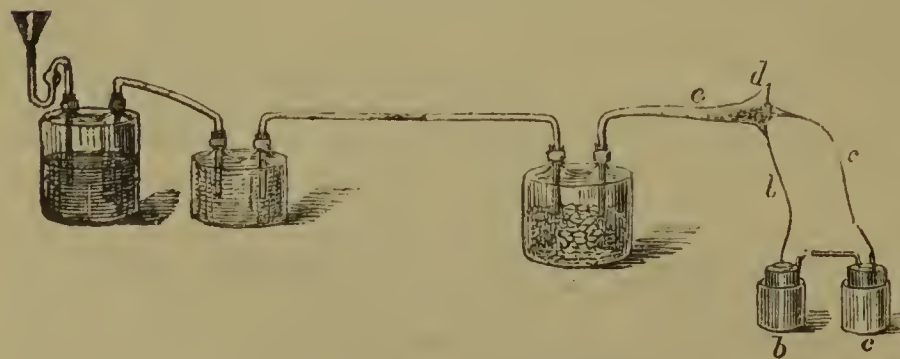


FIG. 15.

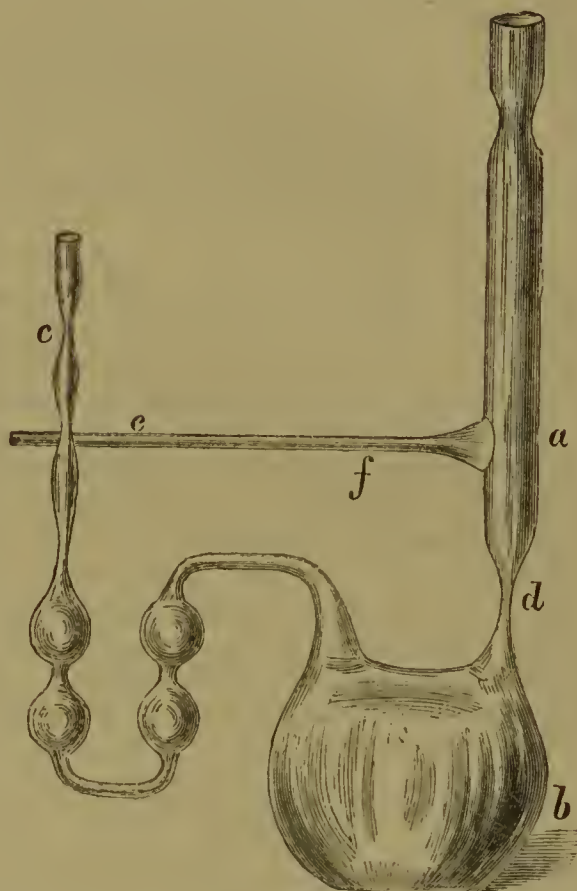


apparatus without the chance of oxidation, the simplifications introduced in the weighings consequent on having the apparatus vacuous, and the facilities obtained for the

employment of the Sprengel and Bunsen pump at different stages of the operations.

Although each determination with this improved apparatus still took many weeks for its successful performance, a great saving of time was effected when compared with

FIG. 16.

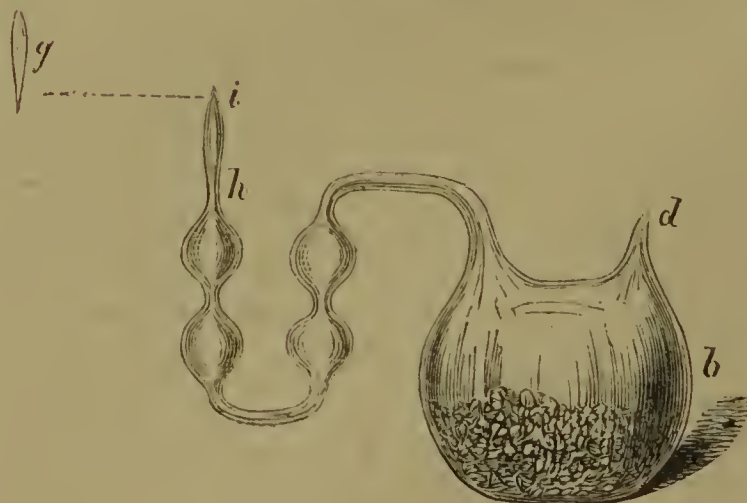


that required for a determination in the apparatus first used, where months were consumed in the evaporations. As this form of apparatus was the one in which most of the determinations were effected, and, as the manipulations

FIG. 17.



FIG. 18.



were attended with greater chances of accuracy than were those at first employed, I will describe the apparatus, its employment, and the several processes performed in it somewhat in detail.

Some of the metallic thallium, prepared by one of the methods already described, is cut by means of a sharp steel knife into prisms about one-eighth inch square and half an inch long, no particular care being taken to avoid oxidation. The prisms are boiled in dilute hydrochloric acid to remove any trace of iron which the knife might have communicated. They are then washed in water, dried with blotting-paper, and introduced into the cylindrical portion *a*, Fig. 16, of the apparatus. The outer extremity of *a* is then drawn out and sealed before the blowpipe. The end *c* is also sealed up, and the horizontal tube *e* is connected to the Sprengel pump and a vacuum obtained, the apparatus and the thallium being kept warm to drive off any moisture which might have been introduced with the thallium. When the vacuum is perfect, the tube is sealed at *f*. The apparatus, sealed up and entirely free from air, is now laid on its side, and the cylinder *a* and the bulb *b* imbedded in a bath of magnesia held in a copper vessel heated by gas. The temperature is then raised to above the fusing-point of thallium (561° F.), when by careful manipulation the oxide may be separated from the liquid metal, and the greater part of the oxide collected at the closed end of the cylinder *a*. The magnesia is then removed from about the narrow part of the tube *d* (which should be somewhat long and very much contracted), and by a dexterous movement the magnesia-bath containing the apparatus is suddenly tilted up, and the liquid metal allowed to run through the contracted part into the bulb *b*. In some instances portions of oxide or of metal stick in the channel; then the operation is lost, and a fresh attempt has to be made with another apparatus; but, if the channel is entirely or in great part clear, it may be sealed up at the contraction, care being taken to apply the heat at such a place that no particles of metal or oxide are entangled in the fused glass.

The apparatus has now the form shown in Fig. 17. It is hermetically sealed, entirely free from air, and contains a certain quantity of pure metallic thallium entirely free from oxide and as brilliant as mercury.

The next operation is to ascertain the combined weight of the apparatus and metal. It is washed on the outside with dilute sulphuric acid to remove any particles of magnesia that might adhere to it, and, after rinsing with water, is dried and gently warmed. Its weight is then taken in the air-balance—not necessarily with extreme accuracy, but to enable a calculation to be made as to how much it will probably weigh in the vacuum-balance at a greatly reduced atmospheric pressure. As the substance weighed consists of thallium and glass in unknown proportions, the vacuum-weight cannot be calculated with any approach to accuracy; but it is generally easy to arrive at some approximation to the relative proportions of thallium and glass, and in this manner the probable vacuum-weight may be estimated.

The apparatus is now transferred to the vacuum-balance, and weights put which it is judged will balance it at an atmospheric pressure a few barometric inches short of a vacuum. The balance-case is then sealed up, and the exhaustion proceeded with. As the rarefaction proceeds, the beam is occasionally liberated until it is found that the apparatus and weight are in equipoise. If the barometer-gauge shows a rarefaction not equal to 25 inches of mercury, the air had better be let in, the requisite additional weight added, and the exhaustion re-commenced; but if, when the balance is in equilibrium, the rarefaction is above 25 inches, the weighing may be continued.

Two sources of error have now to be guarded against:—1. The alteration of temperature inside the iron case, consequent on the rarefaction. 2. The slow and almost unavoidable leakage of air into the balance through the iron, the numerous joints, and the stuffing-boxes. This leakage should not exceed 0.1 inch in an hour.

Equilibrium having been obtained, two or three extra strokes are made with the air-pump, and the exhaustion raised to such a point that by about six hours' leakage the balance is again in equipoise. The weights will at first

appear lighter than the apparatus. The balance is allowed to remain well protected from external thermal influences, until the time has nearly arrived when the leakage of air into its interior has reduced the rarefaction to the point at which the weights and apparatus will be exactly in equilibrium. The observer now enters the room, and, after liberating the beam and setting it in oscillation, watches the movements of the index through a telescope fixed 10 feet off. By reason of the gradual leakage of air, the inequality of the oscillations gradually diminishes, until at last the arcs are of the same value. At this moment the temperature inside and outside the balance-case, the height of the barometer-gauge, and the reading of the standard barometer are observed.

Six hours are generally sufficient to restore the temperature reduced by the exhaustion; but, if the inner and external thermometers differ, I again rarefy by a few strokes of the pump, and repeat the observation after waiting for a few hours longer.

Having obtained the accurate weight in a rarefied atmosphere, the next step is to weigh the apparatus in air of the ordinary density. Air is allowed slowly to enter the balance through the U-tubes at the side, and in a few hours, when the inner and outer temperatures are uniform, the weight is again taken.

For the final adjustment of the weight, the rider may be used. I, however, prefer, as being more accurate, to place a weight slightly in excess in the pan opposite to the apparatus to be weighed, and then, having sealed up the balance, to exhaust a little beyond the point of equilibrium of weight, and continue the operation exactly as in weighing in a rare atmosphere. By taking care that the air contained in the balance shall only be half an inch or so rarer than the external atmosphere, the data afforded by the two weighings will be sufficient to enable the true vacuum-weight of the apparatus to be calculated with accuracy.

This method of ascertaining minute differences of weight, not by the addition to, or subtraction of, material weights from one arm of a balance, but by varying the density of the air in which the operation is performed, is, I believe, attended with a greater approach to accuracy than the method generally adopted. It can, however, only be adopted when the weights and the substance weighed differ in specific gravity.

(To be continued).

ON THE CONDITION IN WHICH SILICON EXISTS IN PIG-IRON.

By E. HANDFIELD MORTON, F.C.S.

THE author was induced to make a few experiments upon the subject of this paper, by noticing that silica was obtained in the insoluble residue when pig-iron containing a large quantity of silicon was dissolved by dilute sulphuric acid *in vacuo* instead of silicon, which might have been expected as the result of the decomposition of the pig-iron under these conditions.

This fact appeared to clearly point out that the theory of the silicon being *intimately mixed* with the pig-iron was untenable, at least as regards this particular pig, which was a No. 1 Bessemer iron containing 4.612 per cent of silicon, and was therefore not at all unlikely to contain silicon in admixture, if that element ever occurred in pig-iron in such a condition. A considerable number of experiments were made with the view of ascertaining how far this conclusion was correct.

Weighed quantities of the Bessemer pig-iron were placed in sealed tubes with Nordhausen sulphuric acid, in atmospheres of carbon dioxide and hydrogen, and also *in vacuo*: the tubes were then heated in an air-bath by two Bunsen burners for twenty-four hours, but in every case the silicon contained in the pig-iron had been converted into silica, and a small quantity of sulphur dioxide formed in the tube, which occasioned sufficient pressure to blow

the top off the tube when cracked with a file. On examining the insoluble residue from these experiments under the microscope, perfectly transparent crystals of silica were observed interspersed with opaque pieces of the same substance. When these insoluble residues were treated with hydrofluoric acid, complete solution was effected.

The next attempt to isolate the silicon in this pig-iron was made by heating weighed quantities of the iron with an excess of pure iodine in sealed tubes, all air being first displaced by carbon dioxide; the same heating arrangement being used as in the sulphuric acid experiments. At the end of twenty-four hours, all iodine vapour having disappeared, one of the tubes were opened and the contents analysed, with the following results:—

Iodine	76.432 per cent
Iron	20.013 „
Silica	1.709 „
Carbon	0.759 „
<hr/>	
98.913	

Directly the tube was cracked the pressure of gas blew the top off. The contents consisted of dull red lumps, the whole of the iron having been converted into the ferrous iodide, as the above figures correspond to the formula, FeI_2 . There can be little doubt but that the silica which was formed in this experiment was due to a slight decomposition of the carbon dioxide, with which the tube was filled; the greatest part of the silicon having been converted in all probability into an iodine compound; for, although iodine vapour is without action upon silicon under ordinary conditions, it is highly probable that when silicon in the nascent state is presented to iodine vapour, a compound of iodine and silicon may be formed. These results were confirmed by several other similar experiments. This pig-iron was also carefully tested for graphitoidal silicon, by treating the iron with hydrofluoric acid; the insoluble residue was filtered off, and ignited to get rid of the carbon, when a mere trace of a dark powder remained, which proved to be iron.

From these results it may fairly be concluded that the silicon contained in pig-iron does not exist in a state of mechanical mixture, but exists combined with a portion of the iron as a silicide of iron, in the same manner that carbon exists as a carbide of iron, only differing from carbon in so far that it does not exist in a graphitoidal form in pig-iron. If the pig-iron used had contained any uncombined silicon, it would have been found in the insoluble residue from the experiments with Nordhausen sulphuric acid and hydrofluoric acid, as it is insoluble in even the latter acid after having been strongly heated; and as any uncombined silicon must have been heated intensely in the blast furnace, there can be little doubt that as a rule pig-iron does not contain any uncombined silicon.

The author then made the following experiments in order to ascertain whether or not the hypothesis of the combination of the silicon with the iron was correct:—0.1694 grm. of the Bessemer pig-iron was placed in a platinum boat, which was then introduced into a porcelain tube. A current of carbon dioxide was passed through the tube to displace the air, after which pure dry hydrogen was passed through until all the carbon dioxide had been driven out. The portion of the tube which contained the boat was then heated for five hours to a very bright red heat in a Fletcher's gas furnace, the current of hydrogen being maintained until the tube was cold. The boat was then withdrawn and weighed, when it was found that a loss in weight of 0.004 grm. had taken place. The gas, as it left the apparatus, was passed through a wash-bottle containing a weak solution of pure caustic potash (prepared from alcohol); at the end of the experiment this solution was made acid with pure hydrochloric acid, evaporated to dryness, and ignited, when an insoluble residue of silica was obtained which gave 0.344 per cent

of silicon on estimation. The iron in the boat (which, after its withdrawal from the tube, showed no sign of oxidation) was analysed, with the following results:—

Iron	92.018 per cent.
Silicon	4.130 „
Graph. carbon	1.622 „

For comparison with the above analysis is subjoined the analysis of the pig-iron used:—

Iron (by difference) ..	92.375 per cent.
Graph. carbon	2.800 „
Silicon	4.612 „
Phosphorus	0.110 „
Sulphur	0.103 „

100.000

This shows that there was a loss of silicon to the amount of 0.482 per cent.

The above experiment was repeated several times with almost identical results. It will be observed that the amount of silicon found in the caustic potash solution very nearly corresponds with the amount of loss of silicon sustained by the iron operated upon; thus, 4.130 per cent + 0.344 per cent = 4.474 per cent silicon, instead of 4.612 per cent, the difference being 0.138 per cent.

In the event of the silicon being in combination with the iron, the author calculated in the above experiment upon the reducing power of hydrogen being able to decompose the silicide of iron, with the formation of siliciuretted hydrogen, which would be decomposed by the caustic potash solution; and this appears to have taken place. Possibly the temperature of molten iron is required to effect the decomposition of the whole of the silicide of iron, or else the attraction of iron for silicon is so strong as to defy, in great measure, the reducing power of hydrogen. This last hypothesis is by no means improbable when the high temperature of molten iron is taken into account; for the fact is pretty generally admitted that chemical affinities are frequently reversed in the presence of an intense temperature.

A sample of white pig-iron containing a large quantity of silicon having been given to the author, he thought it might be interesting to ascertain whether hydrogen had the same effect upon the silicon contained in the white iron as it had upon that contained in the Bessemer iron used in the preceding experiments.

0.1420 grm. of the white iron was heated in the same apparatus, and under the same conditions that existed in the preceding experiments, for six hours at nearly a white heat. When cold the iron was analysed, as was also the caustic potash solution, with the following results:—

Iron	89.201 per cent.
Graph. carbon	1.060 „
Silicon	4.287 „

Caustic potash solution: Silicon = 0.494 per cent.

The composition of the white iron used is shown by the following analysis:—

Iron	90.000 per cent.
Graph. carbon	2.975 „
Silicon	4.704 „
Undetermined	2.321 „

100.000

The amount of silicon found in the caustic potash solution is 0.077 per cent more than is required to account for the loss of silicon sustained by the iron used, which amount may be said to be within the limits of error of experiment.

The following table shows the amounts of loss of silicon sustained by the iron used in these experiments, and also the amounts of silicon found in the potash solutions:—

	Loss of Silicon.	Silicon found in Potash Solution.
Bessemer pig-iron =	0.482 per cent.	0.344 per cent.
White „ =	0.417 „	0.494 „

On comparing the results obtained from the two kinds of iron used, it is evident that the effect of hydrogen upon the silicide of iron is identically the same in both cases, and this has led the author to believe that the amount of silicon lost by the iron in each case is due to the silicide of iron containing an atom of non-saturated silicon, or, in other words, that the silicide of iron was super-saturated, and consequently the non-saturated atom of silicon united with the hydrogen, leaving a lower silicide of iron undecomposed. Whether this is the case or not can only be decided by treating samples of iron containing smaller quantities of silicon in the same manner, and observing whether there is any loss of silicon sustained by them. These and other experiments upon this subject the author hopes to communicate shortly.

Another curious point to be noted in the experiments with hydrogen is that a loss of graphitic carbon has occurred both in the Bessemer and white iron, and the loss in each case is somewhere about the same amount. The author is at present unable to offer any definite explanation of this circumstance, except that the loss cannot be due to the action of oxygen, because, if that had been the case, an oxidation of the iron must have been apparent.

In conclusion, it may be fairly considered, from these experiments, that silicon in pig-iron is contained as a chemical compound of iron and silicon, and not as a mechanical mixture.

Newport, Mon.

ON THE ESTIMATION OF TANNIC ACID.

By C. ESTCOURT, F.C.S.

IN connection with my duties as Public Analyst to the City of Manchester a large number of teas have been examined by me.

The most serious difficulty in a tea analysis has been the estimation of tannic acid, which by either the gelatin or the antimonial methods is extremely tedious. The extreme care necessary to avoid adding too much, and the trouble of filtering, &c., when too little of the reagent is added, are difficulties the analyst would gladly avoid. When in addition the continual titration necessary with both gelatin and standard tannic solutions is mentioned, no more need be said, especially as the experiments detailed at the end of this paper show that a *fixed* proportion of the tannic acid sold as pure is not *precipitated* by gelatin or by antimonial solutions when applied in the ordinary way. Lowenthal's method, consisting of titration with potassium permanganate, dilute sulphuric, and indigo solution as indicator, gives very good results when tannic acid alone is present. As teas contain a considerable quantity of gallic acid, Lowenthal's process alone is not applicable to their analysis. Neubauer modified the foregoing process by titrating one portion of the original solution as above, and then adding to a fresh portion of the solution a quantity of animal charcoal, filtering off, testing solution with sodium acetate and ferric chloride. If no tannic reaction was perceived he titrated as before with potassium permanganate; estimating the difference between the first and second titration as being tannic acid. The animal charcoal, however, in addition to tannic, takes up gallic acid also, so that this method cannot be applied to tea analysis.

After a number of experiments with potassium permanganate and dilute sulphuric, *without* the indigo solution, I found that although constant results were obtainable in colourless solutions (for instance, standard tannic, 20 c.c., made up to 400 c.c.), yet in solutions such as tea extracts, the colour interfered with the delicate rose-pink, which indicated the termination of the reaction.

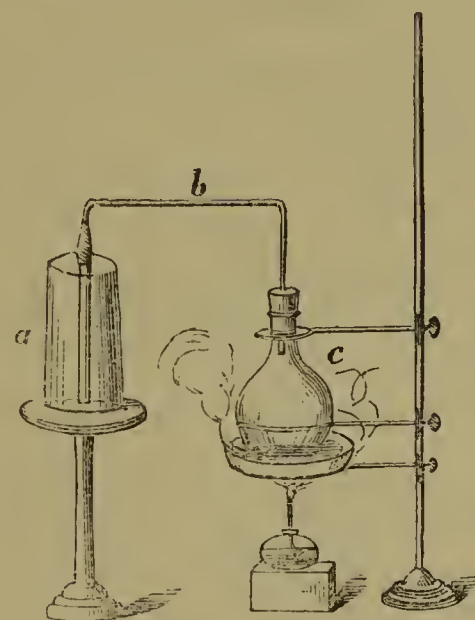
I next tried another series of experiments, first titrating say a measured quantity of tea extract, or of standard tannic solution, with permanganate, dilute sulphuric, and

indigo solution, then precipitating an equal quantity of the same solution by a concentrated solution of gelatin added in excess. When the gelatin is filtered off, and the solution titrated with potassium permanganate, &c., (golden yellow being the indication of end) the difference between the two results should certainly indicate the tannic acid alone.

Having ascertained that a large excess of gelatin solution did not affect the permanganate titration, it remained to provide an easy method of filtration.

Mr. J. B. Cooke in the CHEMICAL NEWS, vol. xxvii., p. 26r, described a method which he employed, depending upon the production of a partial vacuum in a small flask. I found his method rather difficult of application, and devised the following modification:—

a is beaker containing solution to be filtered. *b* is tube passing through caoutchouc cork at one end, and at the other connected by rubber tubing with a piece of glass tubing filled lightly with cotton-wool. This short piece of tube should be of rather larger bore than the other portion. The flask is supported on a ring over a porcelain basin full of water at boiling-point. To filter, the cork



and tube are removed from the flask, and two drops of alcohol are rinsed round it. The flask is then placed in position on retort-ring, with flask-bulb dipping into the boiling water. In a few seconds the cork should be fitted in without removing flask, and the beaker should be placed under the end of the cotton-wool tube, when, on depressing it below the surface of the solution to be filtered, bubbles of air will be seen escaping. Allow this to proceed for one minute, then elevate the beaker so that the cotton-wool tube may touch the bottom, remove the light and the water-bath, and the filtration will commence. It may be hastened by the application of a wet cloth to the flask. In practice most tea solutions (if they have been heated with the gelatin solution to boiling, over naked light) give a clear filtrate at once; if, however, the filtrate comes through opalescent, the remedy is to boil it in the flask for a minute, and pass it through the apparatus again. When this has been done the operation has scarcely occupied twenty minutes altogether.

Reagents Required.

	Grms. per Litre.
Strong gelatin solution (with 1 grm. alum), say	9
Fresh standard solution of tannic acid	2
" " gallic acid	2
Solution of potassium permanganate	1·5%
Dilute sulphuric acid 1 to 4 of water.	

Solution of indigo paste in water about 30 grms. per litre, titrated so that at least 5 c.c. of permanganate solution will be required to produce golden-yellow tint, in 20 c.c. of indigo solution when 10 c.c. of the dilute sulphuric acid are added, the whole being made up to 800 c.c.

I do not find this process so easily applicable in all solutions containing tannic acid, but have found it expe-

ditionous and constant in results in tea, oak-galls, sumach, &c. I need scarcely add that a little alum in some cases facilitates the precipitation greatly. To estimate the tannic acid in tea it is necessary to *boil* it, as the exhaustion of tea by even large quantities of boiling water, though it dissolves out *almost all* the gallic, and a great proportion of the tannic acid, leaves behind a considerable quantity of tannic acid, which may be extracted by boiling. I believe that the *relative* quantities of tannic and gallic acids in tea may, as well as their absolute quantities, afford very useful information, and these can be ascertained with perfect exactness by the method I have adopted.

I conclude by giving details of a few of the experiments, which show conclusively that, with the gelatin or antimonial process, at least 30 per cent of the so-called pure tannic acid (used for standard) is not precipitable by gelatin or tartar emetic, and is therefore possibly not tannic; or else that more than 30 per cent of the compound formed is soluble in the quantity of liquid used in ordinary analyses.

Experiments.

20 c.c. indigo solution, 10 c.c. H_2SO_4 made up to 800 c.c. 6.3 c.c. of permanganate solution produce golden-yellow.

50 c.c. tannic solution + 20 c.c. indigo + 10 H_2SO_4 , made up to 800 c.c. 62.2 (–6.3) c.c. permanganate produce golden-yellow.

50 c.c. gallic solution + 20 c.c. indigo + 10 H_2SO_4 made up to 800 c.c. 89.8 (–6.3) c.c. permanganate produce golden-yellow.

50 c.c. tannic precipitated by excess of gelatin, warmed, filtered, and + 20 c.c. indigo solution + 10 H_2SO_4 made up to 800 c.c. 34.0 (–6.3) c.c. permanganate produce golden-yellow.

Thus, *minus* the quantity due to the indigo solution, we have—

50 c.c. gallic acid require 83.5 c.c. permanganate.

50 c.c. tannic acid require 55.9 c.c. permanganate.*

50 c.c. tannic acid, after precipitation by gelatin, require 27.7 c.c. permanganate.

Now if it is assumed that the so-called pure tannic acid is really pure, and contains nothing else, then exactly *one-half* (50 per cent) of the tannic acid solution forms with gelatin a soluble compound, and, refusing precipitation, is then oxidised by the potassium permanganate.

Then 50 c.c. of the tannic solution contain exactly 0.1 gm. of tannic, and by this process its equivalent is 28.2 c.c. of permanganate.

If, however, as appears not at all improbable judging by the results of many experiments (the few I give being only fair examples) the unprecipitable matter is not tannic but gallic acid, then the standard solution of tannic acid would stand as follows:—2.0 grms. per litre would, in 75 c.c. of it, contain 0.1 gm. pure tannic, and would by the before-detailed process be represented by 42.3 c.c. permanganate of potassium.

I hope to succeed in separating the really precipitable portion from the soluble; it will then not be difficult to try whether the reaction is simply due to the solubility of tannate of gelatin in excess of gelatin. In any case the discovery that the quantities soluble and insoluble are constant is interesting, and will, I hope, cause other enquirers to take the matter up.

January 27, 1874.

ON PHENOL AS A PROBABLE SOURCE OF INDIGO.

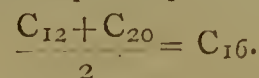
By Dr. T. L. PHIPSON, F.C.S., &c.

In my note "On Phenol-Cyanine" (described in CHEMICAL NEWS, vol. xxvii., p. 299) I held out the probability that indigo might some day be made from it; but phenol-cyanine, according to my analysis of this new substance, only obtained hitherto in very small quantity, contains C_{12} , whilst indigo has C_{16} . I have since endeavoured to

introduce four more equivalents of carbon into the composition of phenol-cyanine.

(1). Phenol-cyanine was melted at a very moderate temperature with acetate of soda, and the product dissolved in concentrated sulphuric acid. On adding an excess of water, a sulpho-acid of a dark purple colour is precipitated.

(2). A similar experiment was made with phenol-cyanine and nitro-naphthaline, equal equivalents of each, for—



The same dark purple sulpho-acid was likewise precipitated by water.

(3). These sulpho-acids, mixed and saturated by ammonia or carbonate of ammonia, gave a small quantity of purple black product, insoluble in water and alcohol, but soluble in concentrated sulphuric acid, producing a dark emerald green solution. This product is very similar, if not identical, to the black indigo produced when the leaves are badly fermented.

THE ESTIMATION OF SILICON, GRAPHITE, MANGANESE, ALUMINIUM, AND CALCIUM IN PIG-IRONS, &c.

By CHARLES H. PIESSE,
Public Analyst for the Strand District.

(Continued from p. 57.)

B. Manganese.

THE filtrate from the silica and graphite is, after dilution with distilled water, heated to boiling, and a little powdered KClO_3 thrown in to ensure the existence of all the iron as per-salt. To ensure this condition it is advisable to test the liquid, by placing one drop of it upon a white porcelain surface, and adding thereto one drop of very dilute solution of K_3FeCy_6 (strength about 0.5 gm. in 300 c.c. of H_2O). To the boiling liquid add then, by means of a pipette, a saturated solution of Na_2CO_3 (taking care to keep the beaker covered, to prevent loss from spirting) until it is nearly neutralised, which will be indicated by a few flakes of the precipitate remaining undissolved, and being careful to keep the liquid boiling the whole time. Pour in, then, 35 to 40 c.c. of a saturated solution of sodium acetate,* and keep the whole well stirred until tranquil boiling sets in, and then let the boiling proceed for a quarter of an hour. Heat, in the meantime, a large stoneware fluted funnel (about 6" diameter at the top), and place upon it an appropriately-sized filter-paper, and then pour in the contents of the beaker; cover the funnel at once with thick folds of blotting-paper, or a wooden disc made for the purpose, in order to prevent the lowering of the temperature. When the filtration is complete, wash the precipitate by pouring upon it about 100 c.c. of boiling distilled water to which a few drops of the solution of sodium acetate have been added, previously replacing the beaker containing the filtrate by an empty clean one, in case the washing-water should carry with it any of the precipitate, thereby necessitating another filtration. When the whole of that quantity has filtered again, wash with 100 c.c. of water with all the same precautions.

A yellowish or reddish tint of the filtrate indicates the presence of a trace of iron, and if that exists the whole must be boiled, a little KClO_3 added, and about 10 c.c. of the sodium acetate solution poured in, the boiling continued for fifteen minutes, and the filtration effected as before. But this will never occur if the acid ferric solution has been carefully neutralised (whilst boiling) with Na_2CO_3 .

The filtrate, mixed with the washings (should measure

* Ammonium acetate may be used if sodium acetate cannot be obtained free from calcium acetate.

not more than about 450 to 500 c.c.), is rendered faintly alkaline by the careful addition of NH_4HO , and heated or cooled, as the case may require, to about 120°F. , and two or three drops of bromine then poured in. After the Br has disappeared about 3 to 5 c.c. of NH_4HO are added, and then, the beaker being covered, is allowed to stand for eighteen hours, the temperature being kept, if possible, at about 100° to 120°F. throughout that period. The precipitate consists of manganic hydrate. Before filtering, boil the liquid; the particles of the precipitate are thereby caused to cohere and sink, and, moreover, the liquid whilst hot passes much more rapidly through the filter-paper. Wash the precipitate by decantation, and finally on the filter, after which it must be dried, ignited, and weighed. Ignition must be repeated until the weight remains constant. The precipitate is then Mn_3O_4 . Multiply the weight of it by 72.107, and divide the product by the weight of the iron employed (actually the same as that for silicon and graphite), and the product will represent the percentage of manganese present in the sample under examination.

C. Calcium.

Evaporate on a water-bath, in a platinum dish, the filtrate from the manganic hydrate until it can little more than retain all the salts that are in solution; transfer it then to a beaker, make it strongly alkaline by the addition of NH_4HO , and add some solution of ammonium oxalate. After allowing the beaker and contents to stand for about twelve hours, the liquid is decanted from the small white precipitate, which is then thrown on to the filter, thoroughly washed, dried, ignited till constant, and the final weight taken. The precipitate consists then of lime, CaO ; its weight is multiplied by 71.428, and the product, divided by the weight of the iron employed, gives as result the percentage of calcium present in the sample.

The results of many analyses of pig-irons made by me lead me to believe that calcium exists as such in nearly all pig-irons, the rule being, with pure irons, that where the greater quantity of carbon exists, there also will be found the greater quantity of calcium. To the subject of the quantity of calcium found in various brands of pig-irons, I propose to return at a future period.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 27th, 1874.

R. ANGUS SMITH, Ph.D., F.R.S., &c., Vice-President, in the Chair.

MR. JOHN WATTS, Ph.D., was elected an Ordinary Member of the Society.

"On a Source of Error in Mercurial Thermometers," by THOMAS M. MORGAN, Student in the Laboratory of Owens College.

While engaged in distillation, a fact has come under my observation which, although it has been noticed before, does not appear to be very generally known, and has not, so far as I have seen, been recorded.

The thermometer, which was placed in a Wurtz tube so that the column of mercury was entirely surrounded by the vapour of the distilling liquid, was found after some days to indicate 3° too little—a discrepancy caused by volatilisation from the surface of the column of mercury and condensation on the upper part of the tube. By causing the mercury to flow to the end of the tube and back, the condensed portion was gathered up, and the correct temperature indicated. It has since been observed that after each day of distillation, with liquids boiling between 60° and 100°C. , a quantity of mercury equal to

1° or 1.5° volatilises, and that this quantity is scarcely perceptible when condensed on the surface of the bore. The thermometer in use was about the ordinary size, with a scale of 360° .

I am informed that Geissler sometimes encloses a little hydrogen in his thermometers, in order that volatilisation may not go on so rapidly.

CORRESPONDENCE.

ALUM IN BREAD.

To the Editor of the Chemical News.

SIR,—In reply to Mr. Jones, whose letter appeared in the last number of the CHEMICAL NEWS, I beg to say that the circumstance of the presence of chloride of sodium in bread had not escaped my attention, and that the possibility of getting chloride of aluminium had been made the subject of investigation. It occurred to me that phosphate of alumina and chloride of sodium might possibly react at a red heat, and yield volatile chloride of aluminium and phosphate of soda; but on making the experiment I failed to notice anything of the kind.

Should any one still fear that such a reaction might cause him to overlook alum in bread, there is a very obvious remedy, viz., the putting of a little carbonate of soda into the bread before submitting it to incineration.

I must confess some degree of distrust in Mr. Jones's observation that common salt, alumina, and sulphuric acid yield the volatile chloride of aluminium; this is, however, matter of experiment, and could be easily settled. Be it as it may, I have run no risk of that kind in the recent cases. In the cases which have given rise to so much controversy in the newspapers, I put 1 c.c. of sulphuric acid into the platinum dish, diluted with a considerable quantity of distilled water, and then boiled down until fumes of hydrochloric acid began to come off; I then diluted again and boiled, and certainly ran no risk, either of loss by volatilisation or by failure to dissolve. I did not employ oxygen gas, knowing that exception might be taken to the result if I had done so.—I am, &c.

J. ALFRED WANKLYN.

March 3, 1874.

ANALYSIS OF NATIVE PHOSPHATES OF ALUMINA AND IRON.

To the Editor of the Chemical News.

SIR.—A lengthened and extensive experience in the analysis of phosphate of alumina and iron has convinced me that the following precautions are absolutely necessary to insure accurate and reliable results:—

(1). *Determination of the Water, Mechanical and Combined.*—The raw phosphates are remarkable for the facility with which they lose water. Even at temperatures much below 212°F. , prolonged exposure removes a large proportion of their combined water. There is invariably a loss of moisture during the grinding operation (however expeditiously conducted), amounting sometimes, in fact, to as much as 1 or 2 per cent. To ensure concordant results, therefore, by different chemists, it is imperative that the total water (=loss by ignition) be determined by igniting the whole, or a large portion, of the sample, previously crushed as rapidly as possible to the size of peas, but not on any account ground.

(2). *Determination of the Phosphoric Acid in the Calcined Mineral, after it has been Ground and Mixed.*—It is well known that the molybdic method is the only one suitable for the determination of phosphoric acid, where much iron and alumina are present, and it is therefore necessary to adopt it in the case of these minerals. It is, I suppose, scarcely requisite to add that soluble silica should be

separated before precipitation, or it will go down with the phosphoric acid.

The necessity for making these suggestions has arisen from the great trouble and annoyance I have experienced from differences in the results obtained by different chemists of high standing from identical, thoroughly mixed, and representative samples.—I am, &c.,

D. E. F.

ESTIMATION OF CARBON AND SILICON IN PIG-IRONS.

To the Editor of the Chemical News.

SIR,—I am indebted to Mr. Allen for the suggestion contained in the latter part of his letter which appeared in C. N., vol. xxix., p. 91, that the BaSO_4 would be more rapidly precipitated by the partial neutralisation of the filtrate, &c., but the results of a very great number of estimations of sulphur—I admit chiefly in irons containing but little sulphur—by various processes has led me to the belief that the error or difference is not a fraction of what Mr. Allen asserts it to be.

Mr. Allen's presumptions lead him quite astray when they lead him to suppose that my experience is confined to the analysis of irons containing but little graphite; my experience resulting chiefly from the analysis of irons which are among the richest in graphite of any to be found in this kingdom; and I repeat, that with a properly heated muffle the graphite can be entirely burned off in "two or three minutes." I admit that the trouble of taring a dried filter makes the process an objectionable one, but not more so than diluting a solution of caustic potash so that it will easily filter, and then evaporating that filtrate, &c., as recommended by Mr. Allen. I think that that is a detail which may well be left to the choice of the operator.—I am, &c.,

CHARLES H. PIESSE.

PS.—I am greatly pleased with the process given by Mr. John Parry in C. N., vol. xxix., p. 86, and I believe that it is destined to supersede the other processes generally in use for the estimation of manganese in spiegeles.

303, Strand, February 23, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, January 12, 1874.

Distribution of Magnetism in Soft Iron.—M. Jamin.—The experiments were made with an iron bar having two bobbins at its extremities traversed by a current. The magnetic results obtained on sending the currents in different (relative) directions lead to a modification, M. Jamin thinks, of the theory of solenoids.

Studies on Diffraction; Geometric Methods for the Discussion of Problems of Diffraction.—M. Cornu.

Physiology of Flight of Birds.—M. Marey.—The author used various artificial birds for experiment. Comparing their wing-stroke with that of corresponding real birds he perceived that the former must be three or four times more rapid than the latter in order to raise the weight. Some condition, then, increasing the resistance of the air under the wing must be wanting in his apparatus. This is, he showed, the translation of the bird. Air shows inertia; that is, submitted to a constant repulsive force it resists strongly at first, then acquires velocity, which it tends to retain after the force has ceased to act. Move a light disc uniformly in a direction perpendicular to its plane. It may be shown with a registering

dynamometer that there is—(1) A considerable resistance at the beginning, from inertia of the air column; (2) a weaker pressure maintained throughout the movement; (3) a tendency to impulsion of the disc when it has stopped, from the acquired velocity of the air column. Thus the resistance of the air to movements of bodies consists of a regular *régime*, preceded and followed by two variable states. The former is that which various experimenters have sought to measure. The resistance of the air attaining its maximum during the initial variable state, it is clear that the wing of a bird would find in the air a more solid fulcrum if, throughout its descent, it were placed in these initial conditions. Now, through translation, the wing at each instant of its descent comes to act on a new column of air, which it tends to depress. But, from the short duration of the pressure, each of these columns has not time to acquire the velocity of the wing; it is thus compressed, and presents the maximum resistance of the initial variable state. To test this theory M. Marey gave his artificial birds a horizontal movement of translation: attaching one, *e.g.*, to the end of a long arm which was driven round while the wings were made to beat by means of a steam-driven air-pump. When the arm was stationary, the wing described between its extreme positions an angle of about 60° . On driving the arm 10 metres per second the amplitude was reduced to 30° and even 20° , showing the effect of resistance of the air on the velocity of the strokes.

On Transformation of a Vitroscope into a Tonometer, and its use for Determining the Absolute Number of Vibrations.—M. Terquem.—The author uses graduated tuning-forks with slides and a small lens (Lissajous). By moving the slides the rates of vibration can be varied throughout an octave. He has other tuning-forks with lenses, but ungraduated. One of the former, or standard forks, and one of the latter, or auxiliary forks, are fixed at right angles in the same horizontal plane, and may thus make horizontal and vertical vibrations respectively. Some powdered antimony is gummed to a branch of the auxiliary fork, and this, illuminated with a lamp, gives bright luminous points. The forks are first brought into unison, and then the variations of the elliptical curve (got from co-existence of the vibrations) when the slides are moved are noted, along with the number of beats in a given time. By a few further steps one is enabled to ascertain the absolute number of vibrations for each note.

Acoustic Pyrometer.—M. Chautard.—The author improves on Dr. Mayer's apparatus. Suppose a tuning-fork before a resonator connected with the two branches of the interference-apparatus of Quincke (as improved by Koenig). From the movable branch a copper tube extends to the enclosure whose temperature is to be measured, and, returning on itself, communicates with a manometric capsule and jet. The fixed branch terminates in a second capsule, which is connected with the same burner. The jet is viewed in a rotating mirror, and the imaged forms vary with the temperature in a way the author describes.

Study on the Storms of the Year 1869.—M. Fron.

Third Memoir on Chemical Dynamics; the Intervention of Water in Chemical Combinations; Electrodes of Water and of other Liquids, and of their Properties.—M. Becquerel.—The author concludes from the facts detailed in this memoir that the method of experimentation employed to determine the electromotor force produced by the contact of two solutions by the employment of electrodes of water, or of other liquids, serves to compare the affinities of the substances in solution, separating the electric effects resulting from hydration from those springing from combinations, so that there is no longer any need of plunging electrodes of gold or platinum into the solutions, which sometimes attack the metal and introduce a source of error.

Heat Disengaged in the Combinations of Oxygen and Nitrogen.—M. Berthelot.—A lengthy paper. The

author concludes that nitrous and nitric acids—leaving out of view the water which they contain—are produced with absorption of heat.

On Chloral and its Combination with Albumenoid Bodies.—M. J. Personne.—A controversial paper on the transformation of chloral into chloroform in the animal economy.

Test-Paper for Urea.—M. Musculus.—Urine, when it has arrived in full alkaline fermentation, is thrown upon a filter. The pores of the paper are soon filled up with globules of a certain ferment, and the filtration slackens. The paper is then washed with distilled water till the alkaline reaction has disappeared, and dried at a temperature of 35° to 40° C. In this state the paper is an efficient test for urea, which, if immersed even in a very dilute solution for ten or fifteen minutes, it converts into carbonate of ammonia. The test-paper should be coloured yellow with turmeric. It is then dried afresh, and preserved in a stoppered bottle. If a slip of the paper is soaked in a solution of urea containing only 1-10,000th part it soon becomes covered with brown spots. If it is required to detect urea in a liquid it must first be neutralised. If alkaline carbonates are present acid enough must be added to decompose the bicarbonates which may be formed. These salts might induce an error. They do not immediately colour turmeric paper brown, but after the lapse of a little time, the brown tint appears, especially on exposure to the air. Neutral alkaline salts do not interfere. The fermentation proceeds as well in the presence of phenic acid as in its absence. The quantitative determination of urea may be also performed with this paper. The solution is placed in a flask with some paper well saturated, and a little tincture of turmeric. Dilute sulphuric acid is added so as to produce the peculiar red (onion peel colour). The flask is stoppered and exposed to a temperature of 25° to 30° for five to six hours. The ammonia formed is then determined volumetrically, the standard acid being added until the red colour of the turmeric is reproduced. The best test-paper is obtained by filtering the white deposit from urine. The detection and determination of small quantities of urea in well waters supposed to be polluted by the drainage of cesspools may easily be performed with this paper. If no reaction is obtained the water may be concentrated.

Bulletin de la Societe Chimique de Paris, tome xxi., No. 1, January 5, 1874.

At the meeting of the Society, December 5, 1873, M. Friedel made some observations on M. Claus's recent paper on the nature of Riboul's dichlorhydric glycide.

M. Schützenberger gave a preliminary notice on the respiratory phenomena of beer-yeast, and described the results he had obtained on bringing *Elodea Canadensis* in contact with a solution of cane-sugar. The saccharose is first inverted. A brisk butyric fermentation is then set up, hydrogen being disengaged, and the liquid becomes acid. If, after some time, the liquid is removed from the *Elodea* the butyric fermentation stops, and is soon replaced by an active alcoholic fermentation. At the same time an abundance of yeast globules appear, of which only slight traces were previously observed.

Phosphate of Cerium containing Fluorine.—M. F. Radominski.—The mineral in question is found in quantity at Kararfvet, near Fahlun in Sweden, and is considered in that country to be monazite. It contains phosphoric acid and oxides of cerium, lanthanum, and didymium; but it contains, also, notable amounts of fluorine and iron oxide, which is not the case with the monazites analysed by Kersten, Herrmann, and Damour. The mineral is found in large crystals of a chocolate-brown colour, and of the specific gravity 4.93. It is very imperfectly attacked by hydrochloric acid, but is completely unlocked by sulphuric acid and bisulphate of potassa.

On Tereben.—J. Ribau.—A claim of priority as against Orłowski.

Transformation of the Essence of Terebenthin and of Tereben into Cymen.—M. J. Ribau.—The author finds that terebenthin in the conditions necessary for its transformation into tereben is partially converted into cymen with disengagement of sulphurous acid, and that tereben treated with sulphuric acid, either hot or cold, is transformed into cymen with disengagement of sulphurous acid.

New Coloured Reactions of Phenate of Ammonia, in Connection with Erythrophenic Acid.—S. Cotton.—Whilst endeavouring (December, 1872) to transform phenic acid into aniline by means of ammoniacal salts, the author repeatedly observed a fine blue colouration. Suspecting oxidation, he was led to try the action of chlorine and of the hypochlorites upon a mixture of phenic acid and ammonia, and observed the following phenomena:—*Action of Alkaline Hypochlorites.*—(1) A mixture of phenic acid and ammonia takes a fine blue colouration in presence of alkaline hypochlorites. Air favours the development of the colour. (2) Phenic acid alone was treated with hypochlorite of lime, heat was applied to destroy the excess of hypochlorite, and ammonia was added to the mixture after it had cooled. No blue colouration. (3) Phenic acid was treated with hypochlorite of lime in the cold and in excess, and ammonia added. Blue colouration. (4) Dry hypochlorite was sprinkled with liquid phenic acid. Heat was disengaged, and the acid became brown. The mixture was placed in a saucer in the midst of a shallow layer of ammonia. Fine blue colouration. The alkaline hypochlorites behave in the same manner. The hypobromites give the same reaction, but much more distinctly and intensely. Ammonia may be replaced by one of its salts, provided always that the hypochlorite or hypobromite contains an excess of base capable of liberating the ammonia. When the hypochlorite acts upon a mixture of the two bodies, heat may be applied without injuring the development of the colour. *Action of Chlorine Water.*—(5) Phenic acid was treated with chlorine water and ammonia added in excess. No colour. (6) Phenic acid was dissolved in ammonia and chlorine water added drop by drop. Greenish colouration passing rapidly into blue. The blue colour is reddened by acids, and restored to its former shade by alkalies and alkaline carbonates. Bromine gives this reaction (No. 6) with more intensity and without any precautions. Iodine has no effect. On repeating the same experiments with the compound ammonias a splendid blue was obtained by treating a mixture of phenic acid and aniline with hypochlorites. The author had unsuccessfully attempted to apply this product in dyeing when in August M. Jacquemin laid before the Académie des Sciences recherches on the same subject. He named the colouring matter erythrophenic acid. (7) A mixture of phenic acid and aniline was treated with chlorine water. Reddish colouration, turned to a blue by alkalies and alkaline carbonates. (8) Aniline, treated with chlorine water, gives the well known violet colouration. The excess of aniline was removed by filtration, and ammonia in excess was added to overcome the chlorine. The liquid turned brown; but on the addition of phenic acid, blue colouration. (9) Inversely, phenic acid was shaken up with chlorine water; after saturation with ammonia in excess aniline was added. No colouration. The hypochlorites yield corresponding reactions, and if they contain an excess of base, aniline may be replaced by its salts. Bromine and the hypobromites give nothing. No similar colourations were obtained by means of chromic acid. The colour derived from the phenate of ammonia has a close analogy with that from the phenate of aniline. The action of chlorine and the hypochlorites upon these two compounds may serve as a distinctive character for phenic acid, but not for aniline. Bromine and the hypobromites are very sensitive reagents for distinguishing phenate of ammonia from phenate of aniline.

New Colouring Matters.—E. Croissant and L. Bretonnière.—The authors have patented a process for

converting organic bodies into true colouring matters. This process is applicable to a number of bodies, many of which are useless and worthless. They enumerate sawdust, humus from old trees, horn, starch, mosses, cellulose, tannin, aloes, &c. The principle employed is the dehydrogenation of the bodies by the action of sulphur at an elevated temperature, which the authors believe replaces the hydrogen. The process is very simple. If, *e.g.*, it is required to convert bran into colouring matter, it is placed in a small sheet-iron tank fitted with a lid. Caustic soda and flowers of sulphur are added in certain proportions, and the whole is made up into a homogeneous paste. The vessel is then placed in a furnace where it can be heated to 250° to 300°. Sulphuretted hydrogen is given off in abundance. When the mixture is dry, we find in the boiler, after cooling, a black friable matter, perfectly soluble in water, to which it imparts a fine sap-green. The solution has a strong affinity for fibres, which it dyes without mordant. One and the same body gives various tones of colour, according to the temperature and the proportions of the mixture. Certain substances, such as extracts of dyewoods, aloes, &c., are converted at boiling-point; whilst lignin, bran, &c., require a higher temperature. The following examples are added:—

- (1) Aloes 3 kilos.
Caustic soda-lye at 40° B. 10 litres.
Water 10 „
Flowers of sulphur. . . . 3 kilos.

The mixture is boiled and yields a lilac-grey. At higher temperatures a deep brown is produced.

- (2) Humus 20 kilos.
Normal sulphide 40 litres.

This "normal sulphide" contains 70 litres soda-lye at 40° B., 65 litres of water, and 30 kilos. of sulphur. To dye cotton, a sufficient quantity of the product is dissolved in water at 60° C., and the goods are worked in this in the usual manner. They are then passed through boiling bichromate of potash, which fixes the colour.

Mode of Employing Gum in Finishing Woven Fabrics.—M. Lafitte.—This paper is unintelligible, the kind of gum used not being mentioned.

Permanganates of the Alkaline Earths.—Tessié du Motay causes caustic baryta to react upon the manganates of potash or soda dissolved in water. Manganate of baryta is precipitated, and is afterwards decomposed with sulphuric acid. The free permanganic acid thus obtained serves for forming permanganates of lime and of magnesia.

Manufacture of Sulphuric Acid.—Martin, of Asnières, proposes to replace pyrites by artificial sulphide of iron, prepared by heating the following mixture:—

- Sulphate of lime . . . 1700
Peroxide of iron . . . 1000
Charcoal 500

Neues Repertorium für Pharmacie, Heft 11 and 12, 1873.

Most Recent Advances in Galvanoplastic, especially as Regards Iron.—Volger.

Collection of Resin in the Black Forest, Baden.—Flückiger.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 2, February, 1874.

New Process for the Manufacture of Beer so as to Render it Unalterable.—M. L. Pasteur.—This paper has been already noticed in the CHEMICAL NEWS.

NOTES AND QUERIES.

Nitrate of Amyl.—I am anxious to make a small quantity of nitrate of amyl. How must I proceed? I have some fusel oil.—R. I. T.

Coal Brasses.—(Reply to K.)—It is not necessary to mix coal brasses with the pyrites for the production of vitriol. The sulphuric acid is very brown indeed. The ordinary pyrites burner will answer with a little management.—R. I. T.

Linseed Oil.—(Reply to F. P. C.)—There is no means known of perfectly separating cotton-seed oil from linseed oil. I shall be happy to supply you with some pure linseed oil if you send me your address.—F. R. G.

MEETINGS FOR THE WEEK.

MONDAY, March 9.—Medical, 8. Anniversary.

— London Institution, 4.

TUESDAY, 10.—Royal Institution, 3. Prof. Tyndall, "On the Physical Properties of Liquids and Gases."

— Civil Engineers, 8.

— Anthropological, 8.

— Photographic, 8.

— Deaf and Dumb Association, 272, Oxford Street, Public Lecture, 8. Mr. Chas. W. Vincent, F.C.S., "On the Beginnings of Electrical Research;" interpreted by the Rev. A. Smith.

WEDNESDAY, 11.—Society of Arts, 8.

— London Institution, 7.

— Geological, 8.

THURSDAY, 12.—Royal Institution, 3. Prof. W. C. Williamson, "On Cryptogamic Vegetation (Ferns and Mosses)."

— Royal, 8.30.

— Royal Society Club, 6.

FRIDAY, 13.—Royal Institution, 8; Weekly Evening Meeting. Dr. C. R. A. Wright, "On the Chemical Changes Accompanying the Smelting of Iron in Blast-Furnaces," 9.

— Astronomical, 8.

— Quekett Microscopical Club, 8.

SATURDAY, 14.—Royal Institution, 3. Mr. C. F. Newton, Keeper of Greek and Roman Antiquities, British Museum, "On Ephesus."

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THE CHEMICAL NEWS.

VOL. XXIX. No. 746.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 105).

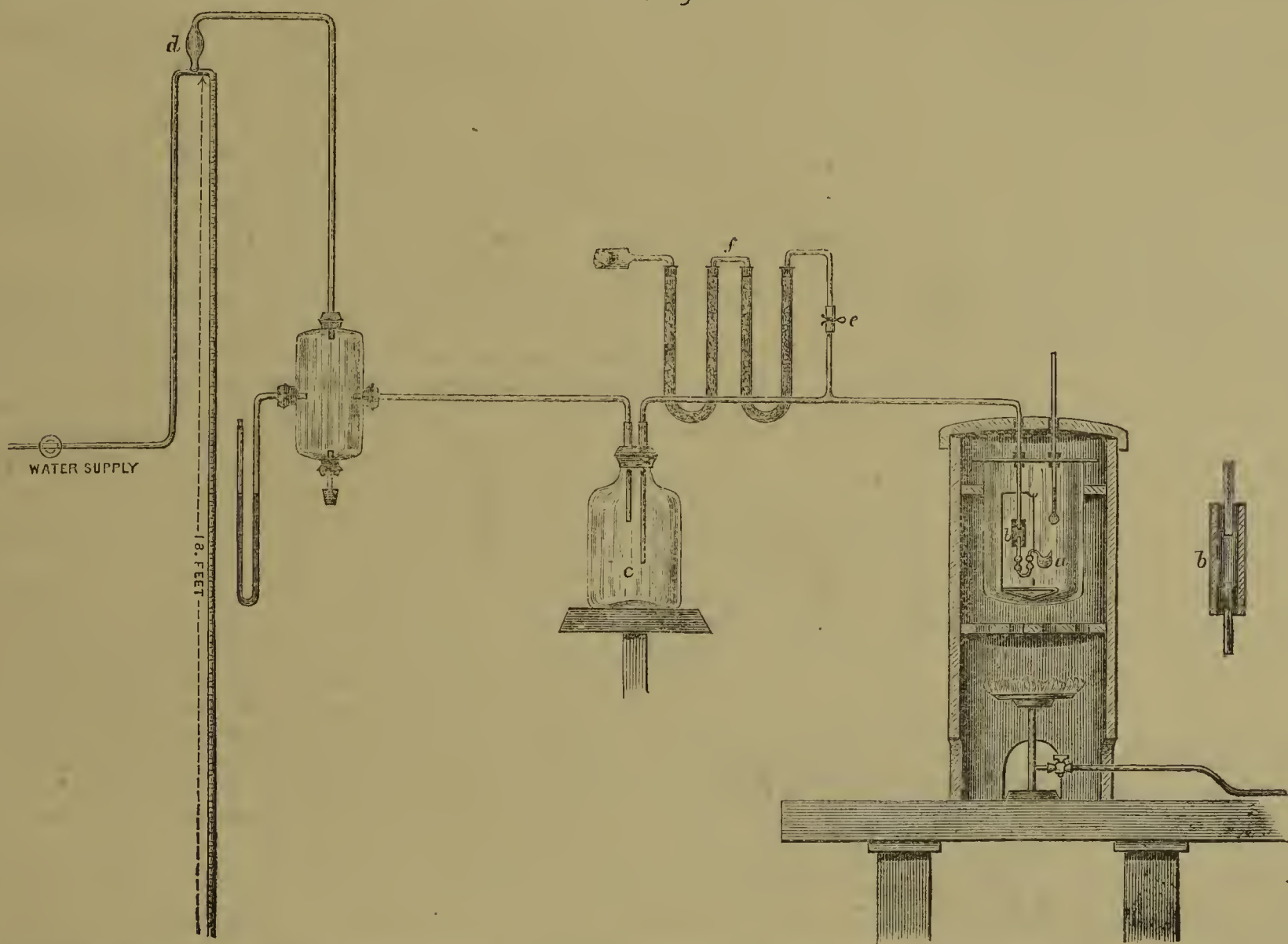
THE data for ascertaining the weight of the apparatus and the thallium it contains have now been obtained. The next operation is to convert the thallium into nitrate. For this purpose, the tube *g* (Fig. 17) must be opened; and to effect this without any risk of losing particles of glass, I gently warm the extremity in a spirit-lamp, and then apply the tip of a blowpipe-flame to the warm glass at *g*. The atmospheric pressure outside, acting against the vacuum

converted into nitrate. The quantity of acid which is allowed to act at a time must be very limited, and the temperature should not be higher than is sufficient to prevent the nitrate of thallium formed crystallising on the metal and interfering too much with the action. As soon as the action ceases, a little nitric acid from the washing-bulbs is allowed to run into the globe, its place being supplied with fresh acid. When cold, the crystallisation of the nitrate of thallium entirely prevents the reaction between the metal and acid, but, on warming, the salt dissolves and the action proceeds. The vapours of nitric and nitrous oxide, which are evolved in abundance, are washed by passing through the system of bulbs, and the reaction must be only just sufficient to cause them to pass through slowly.

In course of time the whole of the thallium is dissolved, and the most tedious part of the process then commences—the evaporation of the excess of free acid.

For this purpose an apparatus is used represented in Fig. 19. *a* is the apparatus connected by a wide tube, *b*, and a narrower glass tube with a bottle, *c*. This is in connection with a Bunsen's water-pump, *d*, having 18 feet

FIG. 19.



inside, immediately perforates a small hole through the glass, into which the air rushes.

Some nitric acid, purified in the manner described, is now removed from the bulb in which it has remained sealed up, and a little is introduced into the bulbs *h* and the globe *b*; this is readily effected by alternately warming and cooling *b*, the perforation *g* dipping under the acid. Sufficient nitric acid must be introduced to three-quarters fill the two lower bulbs and also to moisten the thallium in the globe *b*. The apparatus is then placed in a horizontal position, and the quantity of acid in the bulbs is regulated so as to allow air-bubbles to pass in either direction and be washed without spitting acid out.

No reaction, or scarcely any, between strong nitric acid and thallium takes place in the cold; but on applying gentle heat the metal is attacked, and becomes rapidly

fall of water, and capable of producing an exhaustion equal to 10 inches of mercury. The water is supplied to this pump by an independent pipe and tap attached to a large cistern, so that it can be allowed to work continuously day and night without interfering with the ordinary water-supply of the laboratory. The apparatus *a* is enclosed in a glass case, and stands in an air-bath, the temperature of which can be kept constant by means of a gas-regulator. The water of the pump being set in motion, and a temperature of about 250° F. being maintained in the air-bath, evaporation of the nitric acid commences, the vapour partly condensing in the bottle *c*, and partly being carried away through the pump. As the evaporation of the acid proceeds, the temperature is gradually raised, until ultimately it becomes as high as 380° F., which must not be exceeded in this stage of the operation. In course of time (varying from a few days to as many weeks,

* A Paper read before the Royal Society June 20, 1872.

according to the quantity of acid to be drawn off, and the size of the perforation through which it is to pass) the nitrate of thallium is left in the form of dry white crystals.

The pump is then stopped, and air allowed to enter the apparatus by opening the pinchcock, *e*, connected with the chloride-of-calcium tubes, *f*. The apparatus being cooled, water is added to the nitrate of thallium in the proportion of bulk for bulk, about 1 grain of oxalic acid* being dissolved in the water. Heat is then applied, and the solution boiled until all the nitrate of thallium is dissolved, forming a clear, colourless liquid, which deposits, on cooling, brilliantly-white crystals of nitrate of thallium.†

The nitric acid having been previously removed from the bottle *c* and the rest of the tubes, the apparatus is again fitted to the pump. It is heated in the air-bath, and the water gradually drawn out under diminished pressure, the temperature being kept a little below the point of ebullition of the liquid. When apparently dry, the heat is very carefully raised to 394° F., at which temperature the crystals of nitrate of thallium melt; a little froth at first breaks the surface, but this soon disappears, and the liquid becomes as clear and colourless as water. If sufficient oxalic acid has been added to decompose the pernitate of thallium, no deposit whatever is visible in the liquid; but should any be seen, a fraction of a grain of oxalic acid must be added with the water in the next operation.

As soon as the nitrate is in the form of a clear liquid, the apparatus is allowed to cool,‡ and after being disconnected from the pump is weighed in the air-balance, no particular precautions being taken, however, and the air having free access to the interior of the apparatus.

Water is again added, the nitrate of thallium is dissolved and allowed to crystallise out, and the operation of evaporating the water under diminished pressure in the air-bath is repeated exactly as already described.

The dry nitrate is again fused at 394° F., and, after the whole apparatus is heated to about 420° F. for a few minutes, it is allowed to cool, and is again weighed. If there has been loss of weight, the operation must be repeated till the weights are constant.

When this is the case, the apparatus must be disconnected from the Bunsen water-pump, and attached by its extremity *g*, Fig. 17, to the Sprengel mercury-pump. The air is now exhausted as perfectly as possible, and, when quite vacuous, the tube is sealed up at *i* (Fig. 17) by the application of a small spirit-flame. Care must be taken in doing this to lose no particle of glass, as the end of the tube *g* which is drawn off, having been included in the first weighing, must be carefully preserved and weighed along with the apparatus in all the subsequent weighings.

The apparatus is now of the form shown in Fig. 18. It contains nothing but the pure nitrate of thallium produced from the action of nitric acid on the thallium at first introduced, and is entirely free from air. It is now, with the loose piece of tube *g* belonging to it, to be weighed in the vacuum-balance at two different atmospheric pressures, with all the precautions already adopted in the previous weighings.

When the data for ascertaining the weight of the glass apparatus and the nitrate of thallium are correctly obtained, the weight of the glass apparatus by itself has to be taken.

For this purpose a hole is perforated in the tube *i*, as before described, by means of a blowpipe-flame, and, water being

introduced, the nitrate of thallium is dissolved out, and by repeated washings ultimately removed. The completion of the operation is ascertained by evaporating some of the washing water almost to dryness, and testing by means of the spectroscope. The apparatus is then dried, connected with the Sprengel pump, and after complete exhaustion it is sealed up at *h*, the same precautions being taken to preserve the piece of tube now removed as were adopted in the previous sealing up.

The empty apparatus is now to be weighed at different atmospheric pressures in the vacuum-balance with all necessary precautions, the two loose pieces of glass tube *g* and *ih* being now included, and, from the data thus obtained, its true weight is calculated. There have thus been obtained:—

- a*. The weight of the glass+thallium.
- β*. The weight of the glass+nitrate of thallium.
- γ*. The weight of the glass alone.

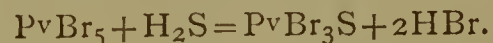
From these data, the atomic weight of thallium can be calculated by the formulæ given in the next section.

(To be continued.)

NOTE ON PHOSPHORUS SULPHOBROMIDE.

By R. W. EMERSON MACIVOR.

THIS compound, the sulphur analogue of phosphoryl tribromide, was first prepared by Baudrimont, who obtained it by transmitting a current of dry hydrogen monosulphide through phosphorus pentabromide, when the following reaction takes place:—



The product of this reaction, however, is always mixed with more or less undecomposed pentabromide, which may be removed by washing the impure substance with water heated to a temperature of about 40° C. By this process of washing, the pentabromide is decomposed into phosphoric and hydrobromic acids, together with a small quantity of the sulphobromide. The purified substance is next pressed between the folds of bibulous paper, and finally placed in an exsiccator over strong sulphuric acid, and allowed to remain there until the last traces of adhering water have been removed.

Phosphorus sulphobromide is at ordinary temperatures a yellowish, crystalline, solid substance, possessed of an aromatic, but very pungent odour, and fusing at 36.4° C. When it has been melted and allowed to cool in a still place, it frequently remains in the liquid condition for weeks; but if the vessel containing it be shaken, or a granular body be dropped into the liquid, crystallisation immediately sets in, and in a short time the whole mass is solid. It is soluble in carbon disulphide, and its solution in this menstruum, if allowed to evaporate, deposits the compound crystallised in octahedra, which have a sp. gr. of 2.87. It is also dissolved by ether. It is slowly, but completely, decomposed by water, the products of the action being hydrogen monosulphide, sulphur, hydrobromic, phosphorous and phosphoric acids.

Glasgow, February 23, 1874.

VALVE FOR GASES AND CORROSIVE FLUIDS.

By ROLAND H. RIDOUT.

REQUIRING some time ago to force fluids into vessels under pressure, I found that usually a small quantity was driven back. The following valve suggested itself:—A piece of glass tube, about 3" long and 3-16ths of an inch internal diameter, has a bulb blown in the middle, the ends being cut off square, and the edges rounded by holding in the blowpipe flame.

A piece of india-rubber tube 3" long, and of such thickness that it will just pass into the bulb-tube. One end of this is tied, either with string or a fine platinum wire. A

* If the action of nitric acid on thallium is allowed to become too violent, or if the nitrate of thallium is long heated with excess of nitric acid, a little pernitate of thallium is formed, which, on subsequent fusion of the nitrate, deposits a brown powder of peroxide of thallium. The oxalic acid is therefore added to decompose the pernitate of thallium. The excess of oxalic acid disappears with the last traces of free nitric acid and water.

† Nitrate of thallium is soluble in 9.4 times its weight of water at 60° F., and in less than one-fourth of its bulk of boiling water. The crystals deposited on cooling are anhydrous.

‡ If a considerable bulk of fused nitrate of thallium is allowed to solidify in a thin bulb, the glass is almost certain to crack, owing to unequal contraction. Many of my operations were spoilt by this cause. By keeping the apparatus in motion during solidification, so as to allow the nitrate to line the greater part of the inner surface of the bulb, this source of danger is avoided.

short distance below the ligature a transverse slit is made with sharp scissors, so that the end is nearly cut off. The uncut part serves as a hinge. Any pressure along the tube will raise the end upon the hinge formed; but when the pressure ceases the slit will be closed, and any further back pressure will only tend to make the junction more complete. The cut edges must be slightly greased, to prevent their cohesion. This tube is then stretched on a piece of glass tube, so that it will with difficulty enter the bulb-tube. The valve-slit should extend to about 1-10th of an inch beyond the glass tube, and then the whole, being greased, is forced into the bulb-tube, till the valve occupies the interior of the bulb and has plenty of room to work. A small pellet of cork or india-rubber is placed in the part beyond the slit, otherwise the pressure would cause it to collapse, and so be rendered useless. I have had no opportunity of testing this valve with pressures greater than 30 lbs. per square inch, but up to this point it is perfectly air-tight. The time one takes to make is about twenty minutes.

Monmouth, Feb. 18, 1874.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 5, 1874.

Professor G. C. FOSTER, F.R.S., in the Chair.

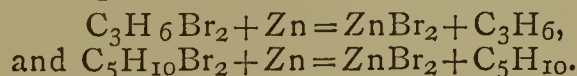
THE names of the visitors having been announced, and the minutes of the previous meeting read and confirmed, Messrs. W. H. Pike, J. G. Lyon, and Magnus Ohren were formally admitted Fellows of the Society. The names read for the first time were those of Messrs. J. A. Fleming, Henry Critchett Bartlett, A. J. Greenaway, Mackay Heriot, William Cunningham, George Henry Beckett, and George Smith. For the third time—Messrs. George Chaloner, Thomas Charles, M.D., Henry Leicester Greville, A. S. Napier, B.Sc., Saranoski M. Nishigaiva, John Linford, James T. Armstrong, Harry Edgcombe Thomas, and F. V. L. Cruse, who were balloted for, and duly elected.

The CHAIRMAN then announced the proposed changes in the Officers and Council of the Society. The Vice-Presidents retiring are Dr. Debus and Dr. Stenhouse, in place of whom it is proposed to elect Dr. Gladstone and Dr. Longstaff. The other Members of Council are Messrs. J. Attfield, J. Dewar, R. Warrington, and C. R. A. Wright, in place of Messrs. A. Crum-Brown, E. Divers, B. F. Duppa, and H. McLeod.

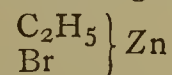
The first paper, "*On the Spontaneous Combustibility of Charcoal*," by Mr. A. F. HARGREAVES, was read by the author. He first noticed the best kinds of wood, and the best method of carbonising them so as to give a charcoal most suitable for the manufacture of gunpowder. The preference is given to black dogwood (*Rhamnus frangula*), which is charred in iron cylinders, the combustible gases evolved from one set being employed to heat the adjoining set: by this means the amount of coal required is greatly diminished. The charcoal produced is generally about 20 per cent of the wood. The temperature at which the operation takes place is very important, as at a low temperature the carbon is too hygroscopic, whilst at a very high temperature it does not burn with sufficient rapidity, and consequently the gunpowder made from it gives a comparatively low velocity. When taken from the cylinders, the charcoal is placed in iron coolers provided with tightly-fitting lids, and allowed to stand for twenty-four hours before it is put into the store-bins. If the charcoal is ground twenty-four hours after burning, and is placed in large iron coolers with the lids off, the temperature gradually rises, and in less

than thirty-six hours afterwards, it takes fire. If ground, however, after an interval of three days, there is no perceptible rise of temperature. From a series of experiments which the author made, it would appear that charcoal continues to absorb oxygen for thirty-six hours after it has been burnt, and the full amount of hygroscopic moisture is only attained after exposure to the air for about two weeks.

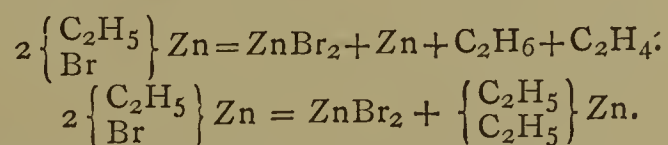
Two papers entitled "*Researches on the Action of the Copper-Zinc Couple on Organic Bodies (Part V., On the Bromides of the Olefines; Part VI., On Ethyl Bromide)*," by J. H. GLADSTONE, F.R.S., and A. TRIBE, F.C.S., were read by the former. The dry couple has but little action on ethylen bromide even at its boiling-point, the products being ethylen and zinc bromide. In the presence of water, however, the bromide is decomposed readily at the ordinary temperature; zinc alone acts but slowly—the reaction in both cases being $C_2H_4Br_2 + Zn = C_2H_4 + ZnBr_2$. In the presence of alcohol, the couple acts so violently that it was found necessary to substitute zinc-foil. In this case no action takes place for half an hour, but it then proceeds rapidly, and is terminated in twenty-four minutes. As the nature of the reaction is the same whether the dry couple is used or whether it is moistened with water or alcohol, it was thought that the difference in the rapidity of the action might be due to the insolubility of the zinc bromide in ethylen bromide. The action of ethylen bromide diluted with twice its bulk of ether was therefore tried, but it was much more sluggish than with water or with alcohol, so that it would seem that the nature of the solvent exerts an influence on the reaction. A detailed account of the experiments made with propylen bromide and amylen bromide was also given, the results being analogous to those obtained with ethylen bromide, the bromide of the olefine yielding the olefine and zinc bromide—



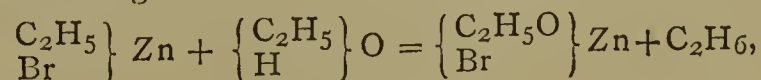
The authors were anxious to investigate the action of the couple on ethyl bromide in order to ascertain whether a zinc ethylobromide and brom-ethylate could be obtained, and also as to whether it would not afford an economical method for the preparation of zinc ethyl. They find that the action between the dry couple and the bromide varies greatly in different experiments, and appears to depend on small differences in the conditions, the nature of which they have not been able satisfactorily to determine. They succeeded, however, in obtaining zinc ethylobromide—



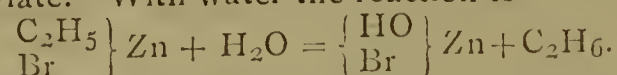
by this means, as also by the direct union of zinc ethyl with zinc bromide. It melts at 62° C., and crystallises on cooling in white pearly scales; when heated it yields zinc ethyl. In some of the experiments no action took place, even when the ethyl bromide was heated with the dry couple for thirty-six hours. When the ethyl bromide is mixed with a little ethyl iodide, the reaction always takes place, and with comparative rapidity, the ethiodide at first formed appearing to facilitate the formation of the ethylobromide. On heating the product, however, only one-third of the zinc ethyl passes over which is theoretically obtainable, probably owing to the comparatively high temperature at which it is decomposed. The reactions which then take place simultaneously may be thus represented—



The action of the couple on ethyl bromide in the presence of water or alcohol is very slow at the ordinary temperature, but proceeds much more rapidly when heated, ethyl hydride being evolved. The reaction with alcohol is—

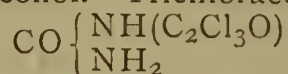


a zinc brom-ethylate being produced analogous to the zinc iodo-ethylate. With water the reaction is—



Professor FOSTER having thanked the authors, in the name of the Society, a paper entitled "*Researches on the Preparation of Organo-Metallic Bodies of the C_nH_{2n} Series of Hydrocarbons*," by Dr. D. TOMMASI, was read by the Secretary. The author, after remarking that the existence of diatomic organo-metallic bodies is possible if the zinc methyl, zinc ethyl, &c., are compounds of the monatomic radicals with metals, said that, although the attempts to obtain zinc ethylene by means of ethylene bromide have failed hitherto, yet he hopes to be more successful by varying the conditions of experiment, or by substituting ethylene iodide for the bromide. He finds that zinc readily attacks a solution of ethylene bromide in common alcohol at the ordinary temperature, with evolution of a gas which proved to be ethylene. The alcoholic solution contains zinc bromide and a small quantity of a compound which is decomposed by water with liberation of zinc oxide. Zinc, however, has no action in the cold on a mixture of the bromide with absolute alcohol. Ethylene bromide, in presence of amylic alcohol or ethylic acetate, is decomposed by zinc at the ordinary temperature; with an ethereal solution an action takes place at 100°C ., but with chloroform there is no action even after several days' heating. Contrary to his expectations, the author found that magnesium had no action on mixtures of ethylene bromide with alcohol, amylic alcohol, ethyl acetate, or ether, either at the ordinary or at a higher temperature. An alloy of zinc very rich in sodium slowly attacks an alcoholic solution of ethylene bromide.

After the author had been thanked by the Chairman in the name of the Society, the Secretary read a "*Note on the Action of Trichloroacetyl Chloride on Urea*," by Messrs. R. MELDOLA and D. TOMMASI. On digesting urea with four times its weight of the chloride for about twenty minutes, the mixture begins to solidify. The heating is continued until the hydrochloric acid and the excess of trichloroacetyl chloride are expelled, and the product is then crystallised from alcohol. Trichloroacetyl urea—



forms tufts of white silky needles, which are readily soluble in warm water, but are decomposed on boiling the solution with formation of an acid, the barium salt of which crystallises in square prisms. The urea melts at 150°C . with partial decomposition. It is also decomposed by boiling with a solution of sodium hydrate, or by digestion with alcoholic ammonia at 100° . With silver oxide it yields silver chloride and a soluble silver salt.

The last paper, on "*The Agglomeration of Finely-Divided Metals by Hydrogen*," was read by the author, Mr. A. TRIBE. During an examination into the nature of the black deposit produced by the action of a dilute solution of copper sulphate on metallic zinc, the author thought that the difficulty of burnishing the finely-divided copper was due to the presence of oxide. Accordingly he treated some of it with acetic acid, when immediately the granular particles of which it consists agglomerated, with an apparent increase of bulk, to a grey sponge-like mass, which assumed a metallic appearance under the burnisher. Dilute hydrochloric acid or sulphuric acid produces a similar effect. After numerous experiments made with a view of ascertaining the cause of this phenomenon, the author ascertained that it was due to the action of hydrogen on the finely-divided metal. A similar effect is produced with palladium or platinum black. The explanation which the author suggests is that the minute metallic particles, by virtue of a species of adhesive attraction, become surrounded by films or layers of liquid hydrogen, the coalescence, or partial coalescence, of which produces the spontaneous inward movement of the finely-divided metal which is characteristic of agglomeration.

At the conclusion of the paper, the meeting was ad-

journed until Thursday, March 19, when there will be a lecture "On Dissociation," by Prof. J. Dewar.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 27th, 1874.

Rev. WILLIAM GASKELL, M.A., Vice-President, in the Chair.

"On the Effect of Acid on the Interior of Iron Wire," by Professor OSBORNE REYNOLDS, M.A.

It will be remembered that at a previous meeting of this Society Mr. Johnson exhibited some iron and steel wire in which he had observed some very singular effects produced by the action of sulphuric acid. In the first place the nature of the wire was changed in a marked manner, for although it was soft charcoal wire it had become short and brittle; the weight of the wire was increased; and what was the most remarkable effect of all was that, when the wire was broken and the face of the fracture wetted with the mouth, it frothed up as if the water acted as a powerful acid. These effects, however, all passed off if the wire were allowed to remain exposed to the air for some days, and if it were warmed before the fire they passed off in a few hours.

By Mr. Johnson's permission, I took possession of one of these pieces of wire and subjected it to a further examination, and from the result of that examination I was led to what appears to me to be a complete explanation of the phenomena.

I observed that when I broke a short piece from the end of the wire the two faces of the fracture behaved very differently—that on the long piece frothed when wetted, and continued to do so for some seconds, while that on the short piece would hardly show any signs of froth at all. This seemed to imply that the gas which caused the froth came from a considerable depth below the surface of the wire, and was not generated on the freshly-exposed face. This view was confirmed when, on substituting oil for water, I found the froth just the same.

These observations led me to conclude that the effect was due to hydrogen, and not to acid, as Mr. Johnson appeared to think, having entered into combination with the iron during its immersion in the acid, which hydrogen gradually passed off when the iron was exposed.

It was obvious, however, that this conclusion was capable of being further tested. It was clearly possible to ascertain whether or not the gas was hydrogen; and whether hydrogen penetrated iron when under the action of acid. With a view to do this I made the following experiments.

First, however, I would mention that after twenty-four hours I examined what remained of the wire, when I found that all appearance of frothing had vanished, and the wire had recovered its ductility, so much so that it would now bend backwards and forwards two or three times without breaking, whereas on the previous evening a single bend had sufficed to break it.

I then obtained a piece of wrought-iron gas-pipe 6 inches long and $\frac{5}{8}$ inch external diameter, and rather more than $\frac{1}{8}$ of an inch thick; I had this cleaned in a lathe, both inside and outside; over one end I soldered a piece of copper, so as to stop it, and the other I connected with a piece of glass tube by means of india-rubber tube. I then filled both the glass and iron tubes with olive oil, and immersed the iron tube in diluted sulphuric acid which had been mixed for some time and was cold. Under this arrangement, any hydrogen which came from the inside of the glass tube must have passed through the iron.

After the iron had been in the acid about five minutes small bubbles began to pass up the glass tube. These were caught at the top, and were subsequently burnt and proved to be hydrogen. At first, however, they came off but very slowly, and it was several hours before I had

collected enough to burn. With a view to increase the speed, I changed the acid several times without much effect until I happened to use some acid which had only just been diluted and was warm; then the gas came off twenty or thirty times as fast as it had previously done. I then put a lamp under the bath, and measured the rate at which the gas came off, and I found that when the acid was on the point of boiling as much hydrogen was given off in five seconds as had previously come off in ten minutes, and the rate was maintained in both cases for several hours.

After having been in acid for some time the tube was taken out, well washed with cold water and soap, so as to remove all trace of the acid; it was then plunged into a bath of hot water, upon which gas came off so rapidly from both the outside and inside of the tube as to give the appearance of the action of strong acid. This action lasted for some time but gradually diminished. It could be stopped at any time by the substitution of cold water in place of the hot, and it was renewed again after several hours by again putting the tube in hot water. The volume of hydrogen which was thus given off by the tube after it had been taken out of hot acid was about equal to the volume of the iron.

At the time I made these experiments I was not aware that there had been any previous experiments on the subject; but I subsequently found, on referring to Watts's "Dictionary of Chemistry," that Cailletet had in 1868 discovered that hydrogen would pass into an iron vessel immersed in sulphuric acid. (See *Comptes Rendus*, vol. lxvi., p. 847.)

The facts thus established appear to afford a complete explanation of the effects observed by Mr. Johnson.

In the first place, with regard to the temporary character of the effect, it appears that hydrogen leaves the iron slowly even at ordinary temperatures—so much so that after two or three days' exposure I found no hydrogen given off when the tube was immersed in hot water. With regard to the effect of warming the wire—at the temperature of boiling the hydrogen passed off 120 times as fast as at the temperature of 60°. Also when the saturated iron was plunged into warm water the gas passed off as if the iron had been plunged into strong acid; so that we can easily understand how the hydrogen would pass off from the wire quickly when warm, although it would take long to do so at the ordinary temperatures. With regard to the frothing of the wire when broken and wetted, this was not due, as at first sight it appeared to be, simply to the exposure of the interior of the wire, but was due to warmth caused in the wire by the act of breaking. This was proved by the fact that the froth appeared on the sides of the wire in the immediate neighbourhood of the fracture, when these were wetted, as well as the end; and by simply bending the wire it could be made to froth at the point where it was bent.

As to the effect on the nature and strength of the iron I cannot add anything to what Mr. Johnson has already observed. The question, however, appears to be one of very considerable importance, both philosophically and in connection with the use of iron in the construction of ships and boilers. If, as is probable, the saturation of iron with hydrogen takes place whenever oxidation goes on in water, then the iron of boilers and ships may at times be changed in character and rendered brittle in the same manner as Mr. Johnson's wire, and this, whether it can be prevented or not, is at least an important point to know, and would repay a further investigation of the subject.

Mr. CARSON desires to correct a statement which appears in a notice read at the meeting on January 13th last, "On a Crystalline Sublimed Cupric Chloride," in which, through a misunderstanding, he stated that sodium chloride was volatilised in Deacon's chlorine process when sodium sulphate is added to the copper salt. He since has learnt from Mr. Deacon that no such volatilisation of sodium chloride has been observed.

AMERICAN SOCIETY OF CIVIL ENGINEERS

December 9th, 1873.

"Note relating to Rumford's Determination of the Mechanical Equivalent of Heat," by Prof. ROBERT H. THURSTON, Member of the Society.

In his "Sketch of Thermodynamics,"* Prof. Tait gives (p. 44, § 78) a *resumé* of the history of the growth of that science, and presents the following as the order of its development:—

First.—Newton's grand general statement of the laws of transference of mechanical energy from one body or system to another (1687).

Second.—Davy's proof that heat is a form of energy subject to these laws (1799).

Third.—Rumford's close approximation to a measure of the mechanical equivalent (1798).

Fourth.—Fourier's great work on one form of dissipation of energy (1812).

Fifth.—Carnot's fundamental principles, his cycles of operation, and his tests of a perfect engine (1824).

Sixth.—Thomson's introduction of an absolute thermodynamic scale of thermometry (1848).

Seventh.—Joule's exact determination of the mechanical equivalent of heat, and the general reception of the true theory in consequence of his experiments (1843-9).

Eighth.—The adaptation, by Clausius and Rankine, and subsequently, with greater generality and freedom from hypothesis, by Thomson, of mathematical investigation (partly based on Carnot's methods) to the true theory; the re-establishment of the great second law by Clausius, with Joule's experimental verification of Thomson's general results (1849-51).

Ninth.—Thomson's theory of dissipation (1852).

Here, as elsewhere, the author of the above *resumé* states fairly the work done by Rumford, but here, as elsewhere, he places his services second in importance to those of Davy, as well as in their actual influence upon the growth of the science of thermodynamics, and does not, apparently, consider them comparable to those of Joule.

In an earlier portion of the work (pp. 7-9, §§ 13-15), the work of Rumford is correctly described, and a value of the mechanical equivalent is deduced and stated at 940 foot-pounds, the estimate being based on the assumption of 30,000 foot-pounds per minute as the true value of a horse-power. The experiment of Rumford consisted in the measurement of the heat developed by the power employed in boring cannon at the Arsenal, in Munich, and his paper describing the method and giving its results was published in the *Philosophical Transactions of the Royal Society of London* for the year 1798.

After showing that the heat evolved through the agency of friction could not have been derived from any surrounding objects, or by compression of the materials employed or acted upon, he says—"It appears to me to be extremely difficult, if not impossible, to form any distinct idea of anything capable of being excited and communicated in the manner that heat was excited and communicated in these experiments, except it be motion,"† and then goes on to urge a zealous and persistent investigation of the laws governing this motion. Estimating the quantity of heat evolved by a power which, as he states, could easily be exerted by one horse, he makes it equal to the "combustion of nine wax candles, each $\frac{3}{4}$ of an inch in diameter."‡ This heat he also states as equivalent to the elevation of "26.58 pounds of ice-cold water" to the boiling-point,|| or 4784.4 thermal units, and the time occupied "one hundred and fifty minutes."

The "horse-power" used by engineers as a unit of power-measurement is 33,000 foot-pounds per minute, but

* "Sketch of Thermodynamics," by P. G. Tait, M.A., Edinburgh 1868.

† *Abridged Phil. Trans.*, vol. xviii., p. 286.

‡ *Ibid.*, p. 284.

|| *Ibid.*, p. 283.

this figure, which was taken by Watt, originally, to represent the "average work of the strongest London draught-horses,"* is much too high for application in estimation of animal power. It is well known among engineers that two-thirds this figure is a more correct value. Rankine† gives for the average draught-horse 25,920 foot-pounds per minute, or 432 per second, and this value, correct as it probably is for Great Britain, is certainly too high for Bavaria. If the horse-power of Rumford be taken at 25,000 foot-pounds per minute—a value far more likely to be correct than 30,000, as assumed in "Sketches of Thermodynamics"—the mechanical equivalent, as deduced from Rumford's experiment, becomes 783.8, differing by only 1.5 per cent from the value now accepted as determined by Joule a half century later, which is nearer the probably correct value than the result of any other investigation, and is even far more accurate than many results obtained by Joule himself.

Could Rumford have eliminated loss due to evaporation, radiation, and conduction, of which loss he was well aware, and to the influence to which he refers, it is very certain that he would have given us a more precise determination of this quantity than even that which is above deduced.

We may then claim for Rumford—

First.—That he was the first to prove the immateriality of heat, and to indicate that it is a form of energy, publishing his conclusions a year before Davy.

Second.—That he first, and nearly a half century before Joule, determined, with almost perfect accuracy, the mechanical equivalent of heat.

Third.—That he is entitled to the sole credit of the experimental discovery of the true nature of heat.

The "second" and "third" of the *résumé* quoted should, therefore, be transposed, even if the work of Sir Humphry Davy should not be deemed simply the supplement of earlier labour and merely corroboratory.

Benjamin Thompson, of Concord, New Hampshire, commonly known as Count Rumford, should be accorded a nobler position and a higher distinction than he has yet been given by writers on thermodynamics.

CORRESPONDENCE.

UNSCIENTIFIC REVIEWERS: PINK AND WEBSTER'S "ANALYTICAL CHEMISTRY."

To the Editor of the Chemical News.

SIR,—My attention has just been directed to a letter signed A. G. P., CHEMICAL NEWS, vol. xxix., p. 90, and I shall feel greatly obliged if you will kindly insert this in reply.

The first so-called extract that A. G. P. brings before our notice is as follows:—"The solution of this salt must be neutral after precipitation of SO_2HO_2 , sulphuric acid" (referring to baric chloride). Here are two misrepresentations; the formula of sulphuric acid being in "Analytical Chemistry" SO_2HO_2 , and not SO_2HO_2 ; the second of in the sentence is in reality *by*. When these corrections are inserted, A. G. P. will be instructed by referring to Galloway's "Manual of Qualitative Analysis," page 406, p. 37; also to "Qualitative Analysis," by Fresenius, page 64, § 58.

In the next attempted extract A. G. P. is again at variance with "Analytical Chemistry;" there is no such formula as CONaO_2 given for sodic carbonate.

In the next paragraph A. G. P. gives some specimens of what he calls "lucid English," with which he says the work abounds, as follows:—"p. 121, 'Manufacture of Oxygen'—A little MnO_2 , manganic oxide, or Fe_2O_3 (peroxide, sesquioxide, or red oxide of iron) added, reduces

the heat required for the giving off of the oxygen, but is liable to contaminate it by traces of Fe or Mn, and from potassic chloride."

In looking over this it would be the impression that in "Analytical Chemistry" the paragraph was headed *Manufacture of Oxygen*, but if your readers will refer to the work in question they will perceive that *Manufacture* is only the *lucid English* of A. G. P.; also chloride has been given for chlorate, and the word *the* omitted. A. G. P. continues—"The conclusion of this sentence seems unintelligible," with which I quite agree, as A. G. P.'s insertions simply read ridiculous.

With regard to his remarks respecting measuring-flasks, it might be well for your readers to refer to "Analytical Chemistry." It has been suggested to me that "Perhaps A. G. P. has never seen one!"

In the next remarks we have again a misrepresentation, as follows:—"Anyone who has seen the pulverulent condition of copper deposited from solution by the action of iron will appreciate the difficulty attending the process of rolling into sheets." If your readers refer to "Analytical Chemistry" they will find that it does *not* propose to precipitate the copper by iron; and it will instruct A. G. P. to obtain "Metallurgy of Copper," in the Weale series, so that he may read the "Electro-metallurgy" on page 221, and then contrast that with "Chemistry," by C. L. Bloxam, page 338, end of paragraph 237.

We now come to the quantitative portion, in which A. G. P. makes the complaint that it is "pre-supposed that the operator has a solution of the substance to be estimated entirely free from other salts." If, in preparing the work, it had been intended for those who were ignorant of the formulæ of sulphuric acid, sodic carbonate, or the difference between a chloride and a chlorate, the usual course adopted by modern writers on quantitative analysis might have been departed from with advantage, but considering the present general state of scientific knowledge it was thought better to follow the usual course.

In the same paragraph we have the following:—"The most frequent, and indeed almost universal, method of estimation appears to be—'Add sulphuric acid, evaporate to dryness, and ignite.'" This is a great misrepresentation as the expression never occurs once. Can such an error have made by mistake?

I shall not trouble your readers with going into the three remaining remarks A. G. P. has thought right to make, as they are of the same description as those already considered.

In conclusion, and in answer to the question of A. G. P. as to what the probable result would be of a student's efforts in pursuit of knowledge were he to "practically follow the course as laid down," I would strongly suggest that it would instruct him with regard to the simple formulæ, and give him a love of truth.—I am, &c.,

G. E. WEBSTER.

Nottingham, March 13, 1874.

ESTIMATION OF CARBON AND SILICON IN PIG-IRON.

To the Editor of the Chemical News.

SIR,—Mr. Piesse appears to misunderstand the reason why I called the taring of a dried filter "objectionable." It was not on account of the trouble only, but chiefly because of the well-known tendency to error involved in the process, an objection which in no way applies to the dilution and filtration of potash. I work on 5 grms., and for siliceous grey irons use about an equal weight of potash. This, after dilution of the solution to about 100 c.c., filters very easily. Of course the solution is acid during the subsequent evaporation.

I cordially agree with Mr. Piesse in his admiration of Mr. Parry's process of manganese estimation. I have long been trying at something of a similar kind. Will

* Bourne.

† "Steam-Engine and Prime Movers," p. 68.

Mr. Parry tell us why he could not succeed in using Bunsen's iodine method? It seems a great pity.

With respect to Mr. Morton's interesting paper on the condition of silicon in iron, I thought the fact of its being in true combination was not open to doubt. It is said that graphitoid silicon has been found in some specimens of foreign iron, and the discovery seems extremely probable. Is it not probable that the diminution of the amount of graphitic carbon observed by Mr. Morton when iron was heated to whiteness in hydrogen, was due to a partial combination of the carbon with iron. The latter element may be said to have been in the nascent condition as it was parting with combined silicon. An estimation of the combined carbon would at once settle the matter.—I am, &c.,

ALFRED H. ALLEN.

Sheffield, March 9, 1874.

NOTICES OF BOOKS.

A Course of Analytical Chemistry, Qualitative and Quantitative. By W. W. PINK and G. E. WEBSTER. London: Lockwood and Co.

If England is at present less prolific in original chemical research than are certain neighbouring countries, she is, by way of compensation, remarkably fruitful in compilations, abridgments, manuals, and elementary treatises. Upon the work before us it is not very easy to pass judgment. For its size, it contains a fair amount of information, not unmixed, we must add, with errors. It would be hard to point out any distinctive superiority which this work possesses over other works on the same subject. Such being the case, we scarcely see the reason for its publication.

The authors devote a considerable space to an exposition of "modern" chemical nomenclature and notation. They strongly advise students to obtain a complete knowledge of "constitutional" formulæ, "because the other is now not recognised by many colleges or allowed in many examinations." An important reason, certainly, in these days when, as Professor Huxley has recently reminded us, we study "not to know, but to pass," with the natural result that we "pass and do not know." But is not this exalting formulæ into an end, instead of making them a mere means to an end? Is it fair to reject a candidate well grounded in the facts of our splendid science because he is not versed in undemonstrated hypotheses and cannot express compounds in the fashionable symbols of the day? If it were desired to overtax the brain of a young man and inspire him with a loathing for chemistry, it would be difficult to devise a more effectual plan than compelling him to commit to memory a quantity of "constitutional formulæ." The old story of the doctor who thought he had explained the power of opium to produce sleep, by saying that it had a "soporific quality," repeats itself. We, too, give some new name to an old fact and dream that we have explained it.

Elements of Chemistry, Theoretical and Practical. By W. A. MILLER, M.D., LL.D.; revised by HERBERT MCLEOD, F.C.S. London: Longmans, Green, Reader, and Dyer.

FEW systematic works on chemistry contain so large an amount of accurate information as the "Elements" of the late Dr. Miller. The author was remarkably successful in selecting the most valuable matter, and in presenting it to his readers in a compact and available form. Hence his book has been deservedly viewed with great favour, of which the appearance of this fifth edition is full proof.

The "revision," entrusted to the hands of Mr. McLeod, does not seem to be confined merely to the addition of facts discovered since the death of Dr. Miller. An alteration has been made in the order in which the non-

metallic elements and their compounds are described. "Seven typical elements," and their respective combinations, are described before noticing those of which they are taken as representatives. Oxygen is removed from the first place to make room for hydrogen and chlorine, which latter element is, of course, separated from its analogues, bromine, iodine, and fluorine. The new arrangement is, therefore, not without drawbacks. The arrangement of the metallic elements has not been altered. "Constitutional formulæ" have been occasionally introduced, which the Editor considers consistent with the ideas developed in the earlier editions.

Exercises in Qualitative Chemical Analysis. By W. DITTMAR. Manchester: Galt and Co.

THESE exercises are arranged in a novel manner. Instead of taking the elements or groups of elements in orthodox order, and describing their characteristic reactions in the wet way, the author commences with the reactions of such bodies as mercuric oxide, iodine, iodic acid, metallic arsenic, and arsenious acid in the dry way. From these he goes on to coloured flames, spectroscopic reactions, and the results obtained by heating metallic oxides with borax. Tests in wet way are next introduced in a similar manner, the student being gradually led from simple to more complex cases, and learning the properties of the substances examined and their characteristic reactions simultaneously with manipulative details. It seems to us that chemistry might be very successfully and thoroughly taught in this manner.

Practical Examples in Quantitative Analysis, forming a Concise Guide to the Analysis of Water, &c. By E. FRANCIS, F.C.S. London: Lewis.

THE analysis of water, though put forward in exceptional prominence in the title, is not the only topic of this work, as milk and urine are also introduced. The processes recommended are grouped respectively as gravimetric, volumetric, and colorimetric, with accompanying descriptions of the apparatus and manipulations required. As examples of the former analytical method, we have the determination of the total solids in milk and urine, the "estimation"—When will certain chemists remember that "estimation" and "determination" are in strictness two very different things?—the determination of uric acid and albumen in urine, &c. As instances of volumetry, the author gives the determination of chlorine in water, of the hardness of water, of urea in water, of sugar in urine and in milk, and of cream in milk. With the "colorimetric" section, the determination of albumenoid and ureal ammonia, which is in substance borrowed from the well-known work of Wanklyn and Chapman, our readers are doubtless well acquainted.

The following passage meets with our full approval:—"A water must not be condemned for containing nitrates, unless recent contamination is proved by an excessive yield of albumenoid and ureal ammonia." The author might have added: "A water must not be pronounced fit for human consumption on account of the absence of nitrates, if recent contamination is proved by a large proportion of free and albumenoid ammonia."

Price List of Chemicals. From Dr. Theodor Schuchardt's Chemical Works, Görlitz, Prussian Silesia.

A PRICE-LIST of nearly 2000 chemicals, besides titrated solutions, sets of apparatus, technological collections, and minerals. A few quotations of the rarer articles may be interesting to English chemists:—Vanadic acid (pure), 4s. 6d. per grm.; bili-fuxin, bili-humin, bili-prasin, bilirubin, and bili-verdin, 8s. 6d. per 5 centigrms.; chlorate of cæsium, 10s. 2d. per grm.; indium (metallic), 12s. per grm.; inosite, 14s. 6d. per grm.; niobium (metallic), 11s. 6d. per grm.; rubidium (metallic), 26s. per grm.; thallium (metallic), 6s. 9d. per 10 grms.; vanadium (metallic), 45s. per grm.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, January 19, 1874.

Theory of Shocks.—M. Resal.

Temperature observed in the Jardin des Plantes with Electric Thermometers, to 36 metres Depth, during the Meteorological Year 1873.—MM. Becquerel.—It appears that in turf-covered ground the temperature, to the extent of some decimetres under the surface, is higher at 6 a.m. than at 3 p.m. in denuded ground, and that at 3 p.m. the contrary is the case, while the average annual temperature is nearly the same in both kinds of ground. This is of some importance in vegetable physiology. For example, it is not a matter of indifference whether plants, whose roots are susceptible to frost, are put in turf-covered or bare ground.

Vibratory Movement of an Elastic Wire connected with a Tuning-Fork.—M. Gripon.—The author experimented by attaching a capillary glass tube to a tuning-fork, allowing the open end to dip in water, and noting the changes of the liquid column through vibration; or, the tube being horizontal, introducing a drop of mercury, and marking the effects of vibration.

Measurement of the Magnetic Moment of very small Magnetic Needles.—M. Bouty.—Conceive a rigid support movable about a vertical axis. Fix to this support—(1) A horizontal needle, the magnetic moment of which, M , is known; (2) a needle whose magnetic moment, x , is to be determined. The needles are placed one above the other so that their axes are at right angles, and at such a distance that their reciprocal action does not alter the distribution of magnetism in each. The system takes through terrestrial magnetism a certain position of equilibrium; the needle M making, with the plane of the magnetic meridian, an angle, α , determined by the equation— $x = M \tan \alpha$. The moment, x , being small enough in relation to M , the angle, α , may be ascertained by the optical method of Gauss and Weber; the image of a scale in a small mirror borne by the support is viewed with a telescope. By this method the author determined the magnetic moment of needles measuring 1 to 2 millimetres in length, and 0.2 millimetre diameter.

Thermic Formation of the Oxides of Nitrogen in the Gaseous State from their Elements.—M. Berthelot.—A lengthy paper, not adapted for abstraction.

Discovery of a Deposit of Bismuth in France.—M. Ad. Carnot.—The substance of this paper has been already given.

Methods of Producing Black Phosphorus.—M. E. Ritter.—The black state of phosphorus is traced to the presence of arsenical impurities.

Existence of Two Isomeric Modifications of Anhydrous Sulphate of Soda.—M. L. C. de Coppet.—Anhydrous sulphate of soda, obtained by drying Glauber's salt at common temperatures, is not identical with that produced by drying the same salt at temperatures above 33° C.

Solubility of Succinic Acid in Water.—M. E. Bourgoin.—This paper has been already noticed.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 6, February 5.

Sulphur in Sicily.—The amount of sulphur remaining in the Sicilian mines is estimated at 40 to 50 million tons. If the mean annual consumption should rise from 160,000 tons (the present rate) to 240,000 the supply would still suffice for two centuries.

No. 7, February 19.

This number contains no chemical matter.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 19, December 22, 1873.

Continuation of Researches on Certain Oxidising and Reducing Agents.—Julius Thomsen.—A thermochemical paper.

A Third Isomer of Pyruvic Acid.—W. Markownikoff.—A preliminary notice.

On Oxypropan-Sulphonic Acid.—A hypothetical paper not adapted for abstraction.

Reply.—A. C. Oudemans.—A continuation of the controversy between the author and Landolt (Heft xvii., p. 1282).

Ultramarine Compounds.—G. Scheffer.—The author finds that if the development of ultramarine is checked a yellow body is formed, which, if the process is continued, becomes red and ultimately blue. The colour passes gradually from pure yellow through orange, red, and violet, and then changes suddenly to blue, so that well-characterised blue granules may often be found in the violet. The following analyses show the composition of these successive stages:—

		I.	II.	III.	IV.
Raw.	Na ₂ SO ₄ ...	28.83	24.50	17.95	19.32
Washed.	SiO ₂ ..	49.55	46.35	49.38	50.64
	Na ..	8.97	9.93	11.90	12.00
	Al ₂ O ₃ ..	22.13	23.30	20.35	20.95
	St ..	13.22	13.96	14.02	13.46
	Sβ ..	12.27	12.15	12.00	11.05

I. is the yellow, II. the red, III. and IV. the blue. In the above analyses the author neglected to separate the chemically combined silica from that mechanically mixed, also from the sand and the undecomposed clay. The latter substances were found in subsequent analyses to amount, on an average, to 10 per cent. St is used to signify the total quantity obtained by fusing the compound with saltpetre and hydrate of potassa. Sβ denotes the amount of sulphur which remains on decomposing the substance with hydrochloric acid. Yellow and red ultramarine contain not a trace of free sulphur, which is, however, found in the blue, and can be removed by roasting or by means of bisulphide of carbon.

On Sulphoxy-Tetrachloride.—A. Michaelis and C. Mathias.—Sulphoxy-tetrachloride gradually undergoes a molecular change, and becomes a liquid of the same ultimate composition, composed of equal equivalents of thionyl-chloride and sulphyryl-chloride.

Analysis of Two Minerals from Greenland.—J. V. Janovsky (continuation).—It has been already stated that the mineral resembling zircon-syenite contains triclinar as well as monoclinar felspar. It is colourless, and is inter-penetrated here and there with green acicular crystals, which probably belong to the mineral resembling hornblende. Sulphuric and hydrochloric acids do not readily attack the pulverised mineral. Before the blow-pipe it fuses only at the angles. The specific gravity is 2.638; it contains—

Silicic acid ..	57.63
Alumina ..	24.32
Ferric oxide ..	3.92
Lime ..	7.65
Magnesia ..	0.68
Potassa ..	4.03
Soda ..	2.41
Loss on ignition ..	0.12

100.76

From the ratio of the oxygen, 7 : 3 : 1, it corresponds with labradorite rather than with oligoklas.

Analysis of a Mineral from Orawioza.—J. V. Janovsky.—The mineral in question, which has been

considered as Gehlenit, is green and granular. Closer examination showed that these green granules contained Vesuvian. The Gehlenit is superficially covered with a reddish-brown crust, which is soft and easily separated from the rest of the mineral. The green olivin-like granules are hard, with white streak; the finely ground substance is easily decomposed by hydrochloric acid and gelatinises. Before the blowpipe it does not even fuse superficially. The specific gravity is 2.997; it contains—

Silica	32.39
Alumina	18.53
Ferric oxide	1.25
Ferrous oxide	3.61
Lime	37.65
Magnesia	6.69
Loss in igniting	0.51

100.63

The imbedded grains of Vesuvian are grey, streak reddish. They lose on ignition 2.12 to 2.34. They contain—

Silica	36.31
Alumina	23.36
Ferric oxide	2.99
Ferrous oxide	0.51
Lime	25.32
Magnesia	5.19
Potash	3.35
Water	2.12

99.15

The superficial crust above-mentioned is soft, amorphous, garnet-coloured; before the blowpipe it gives the reactions of silica and iron, and gives off much water if heated in a flask; it contains—

Silica	27.98
Alumina	30.23
Ferric oxide	8.51
Water	29.36
Carbonate of Lime	3.76
Carbonate of magnesia	0.55

Chemical Intelligence from St. Petersburg.—A. Kuhlberg.—A. Tawildarow is still engaged with an examination of the bromine substitution products of ethan. A. Scherbatshev has investigated the relation between the solubility of salts and their crystalline water. N. Ljubavin has continued his researches on the action of ammonia upon valeraldehyd. Setschenow has examined the absorption of carbonic acid by saline solutions. Louginin has made a communication on the amount of heat liberated when the anhydrous chlorides of certain fatty acids are decomposed by water and solution of potassa.

Intelligence from Lund.—W. Blomstrand.—Mauckhoff gives a description of the masses of native iron found in the basalt of Ovifak, in Greenland, with analyses of the accompanying minerals. Oeberg has examined the eukrit of Radmon Island, in Upland. C. M. Feilitzen has analysed Swedish dolomites and magnesiferous limestones from various localities. De Laval's investigations on the chlorides of tungsten confirm the results previously obtained by Lund. Atterberg has examined the bromine compounds of molybdenum. Pahl's dissertation on the pyrophosphates is an important contribution to our accurate knowledge of that class of salts. Cronander has experimented on the compounds of perchloride of phosphorus with the chlorides of arsenic, tungsten, molybdenum, uranium, chrome, and iron. Petersson has investigated the selenic alums, and the quantitative determination of selenic acid. He prefers Bunsen's method as directed for chromic acid. The substance is boiled with concentrated hydrochloric acid, and the liberated chlorine determined by means of iodine and hyposulphite of soda. P. Hakonsson has examined toluol-disulphuric acid. Paykull has experimented on the compounds of zirconium. Cleve and Høglund have studied the yttrium and erbium com-

pounds. They confirm the results of Berlioz, Bahr, and Bunsen, and show that Mosander's terbia is a mere mixture of didymia, yttria, and erbia. They determine the equivalent of yttrium as 59.70, and that of erbium 113.7. Quantitative methods of separating the two earths are still wanting. Cleve's dissertation on the platinum bases, drawn up in the English language, appears in the *Svenska Vetenskaps Akad. Handlingar*, 1872, vol. x., No. 9. Topsoe and Christiansen have published in the *Danske Vidensk. Selsk. Skr.*, 5 r., band ix., 1873, their important crystallographic optical researches. H. Hvoslef obtained santonic acid in 1863 by the method adopted subsequently by Cannizzaro and Sestini.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 1, January, 1874.

Report Presented by M. Cloëz, on behalf of the Joint Committees of Chemical Arts and of Agriculture, on a Remonstrance of the Paper Manufacturers against the Proposed Duty on Salt Employed in Chemical Works.—The report shows the serious injury which the paper trade must suffer from an increase in the price of chloride of lime and of soda.

Apparatus for Decanting and Treating Ammoniacal Liquor Employed at the Vaugirard Works of the Paris Gas Company.—The ammoniacal liquor is pumped into the first of four large tanks, and after being allowed to settle, passes successively over very shallow outlets into the three others, and is thus freed from tarry matters.

Colouration of Glass with Gold.—M. Payard, chemist to the Baccarat Glass Works.—Gold serves in the glass manufacture to produce rose and red shades. A certain quantity of auriferous glass is prepared beforehand, and run in thin plates. Fragments of these plates are used by the glass-blower to fuse upon his work, and thus give a superficial colouration. It often happens that one and the same composition of auriferous crystal gives plates of very different shades, some colourless, others tinged more or less deeply with rose or red, and some almost black. These differences are due to two physical causes—the temperature of the furnace in which the fusion has been effected, and the temperature of the mould into which the melted material is run. For light coloured plates the temperature of the furnace must be low, and the mould very cold. Blue plates are sometimes produced under the same circumstances, which, if re-heated, take the normal colour, as do also the colourless and very pale rose glasses. These curious facts render it probable that the colouring matter is neither a salt nor an oxide, but a simple body. Crystal coloured with gold is therefore merely a vitreous matter holding in suspension metallic gold in a state of very fine subdivision. On attentively examining the red plates it is easy to recognise in the mass a multitude of brilliant specks of metallic gold forming a sort of aventurine.

MISCELLANEOUS.

Andersonian University.—The Trustees of the "Young" Chair of Technical Chemistry met with the Bursars studying for the last two years under that Chair in the University on January 28. Mr. James Napier, F.C.S., one of the Trustees, intimated the results of the competitive examination which had taken place on December 23. Mr. Napier said the Trustees felt it due to the donors of the bursaries to be able to show what progress was being made by the students, and for this purpose a series of questions upon the branches of chemistry which had formed the course of study for the two years had been prepared by Dr. Robert Angus Smith, F.R.S., Manchester, and placed before the students for written answers, on the occasion referred to. The papers containing the answers had been immediately transmitted to

Dr. Smith, and the result was now communicated to the students—prizes, the gift of the Professor, being awarded to the two whose names stood highest on the list. Dr. Smith stated in his report that “the students appear to me to have attained a great amount of accurate knowledge of a very practical kind, and if the institution sends out men with such information, and so capable of expressing it, the duty laid upon it is most effectively performed.” Mr. Napier then urged on the students close attention to their studies, and asked them not to forget that technical chemistry was greatly promoted by a knowledge of natural philosophy, and that proficiency in science can only be attained by hard labour. Professor Bischof expressed the hope that ere long the fact of young men having passed through a course of technical science in the Andersonian University would be regarded as a recommendation by manufacturers, and concluded by proposing a vote of thanks to Mr. James Young for his liberality in establishing the Chair, and to the donors of the bursaries for their kindness in enabling the students present to obtain the knowledge which they had exhibited.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

An improved sheep dip, which is also applicable to animals other than sheep. Michael Wheelwright Ivison, civil engineer, Glasgow, Lanark, North Britain. April 17, 1873.—No. 1385. The feature of novelty which constitutes this invention consists in compounding or mixing together green gas oil, palm oil, or other grease or fat, caustic soda, caustic potash, water, and glue, so as to form a dip for sheep and other animals.

Improvements in the treatment of night-soil and sewage matters, and in the manufacture of manures therefrom. Henry Young Darracott Scott, Major-General, C.B., Ealing, Middlesex. April 21, 1873.—No. 1445. The object of this invention is the economical and inoffensive treatment of sewage and night-soil. The process essentially consists in the utilisation of the deposit obtained from liquid sewage by the lime method of precipitation, for the deodorisation of the night-soil of towns, and the retention of the fertilising elements of such excrementitious matters.

An improved compound to be used as a vehicle for paints used in house, ship, and general work. Joseph Edmond Tavenet, Paris, France. April 21, 1873.—No. 1446. This improved vehicle, to be used as a substitute for linseed or other siccative oil or liquid, is composed of—100 parts, by weight, of hot water; 4 parts of potash; and 6 parts of carbonate of soda. This mixture, when dissolved, is boiled, and 2 parts of colophony and 10 parts of oleic acid then added separately; after which the whole is boiled until completely dissolved. The proportions specified may be varied.

Improved combinations of ingredients for cleansing and bleaching wools and other suitable fibres and fabrics. James Bateson Rickards, “The Green,” Kilburn, Middlesex. April 22, 1873.—No. 1460. Combination No. 1 consists of—Silica, soda, charcoal, sand, dissolved in water. Combination No. 2 consists of—Silica, potash, charcoal, sand, and water as before.

Improvements in the manufacture of gas for illuminating and other purposes, and in apparatus connected therewith. Isham Baggs, practical chemist, High Holborn, Middlesex. April 23, 1873.—No. 1471. This invention consists in certain improved methods of obtaining, treating, separating, and purifying gas for illuminating and other purposes, obtained by the decomposition of water in connection with incandescent carbonaceous materials, and which methods are partly improvements upon an invention for “Improvements in the manufacture of inflammable gases and in their application to useful purposes,” for which Letters Patent were granted to the applicant, bearing date the 23rd day of October, 1865, No. 2719.

Improvements in the production and treatment of colouring matters. John Henry Johnson, 47, Lincoln's Inn Fields, Middlesex. (A communication from Edward Croissant and Louis Marie François Bretonnière, both of Paris). April 24, 1873.—No. 1489. This invention relates to a mode of obtaining colouring matters soluble in water, suitable for dyeing textile fibrous substances of all kinds, from organic substances not hitherto employed for that purpose, by a simple and economical process, which process is also applicable to the treatment of known colouring matters, with a view to improving the quality of the colouring matter so treated. The improved process consists in the direct treatment of the organic or other body to be operated upon with alkaline sulphides or polysulphides at a more or less elevated temperature, which may range from 100° Centigrade to, say, 350°, according to the nature of the substance under treatment and the tint required—he more elevated the temperature, the darker being the tint obtained.

Improvements in recovering iodine from phosphates of lime during the manufacture of superphosphate of lime, and in apparatus therefor. Dr. Louis Thiercelin, Paris. April 25, 1873.—No. 1500. The object of the invention consists in recovering the iodine from phosphates of lime during the manufacture of superphosphate of lime, which I obtain by causing the sulphuric acid to act on the phosphate in a closed vessel instead of an open vessel as was hitherto done, which vessel communicates with an air-pump or other exhausting apparatus for carrying

the evolved vapours and iodine into a condensing chamber and in suitable alkaline solutions.

Improvements in the treatment of sewage matters and the deodorisation of night-soil. Major-General Henry Young Darracott Scott, C.B., Ealing, Middlesex. April 25, 1873.—No. 1509. Instead of converting into charcoal as heretofore the solid matters deposited from sewage by precipitation with lime or lime and clay, I subject them to a temperature only sufficiently high to decompose their organic matters, and so far scorch or only partially char them, so as to develop in them compounds of a tarry nature, but not completely to expel such compounds as is done in the preparation of charcoal. Sewage deposits thus treated exercise a remarkable effect in destroying the noxious smell of putrescent compounds, and they may be used with great advantage in deodorising night-soil and rendering it innocuous.

NOTES AND QUERIES.

Separation of Magnesium and Calcium.—Will any of your numerous readers kindly inform me as to the best method of separating manganese and calcium, when the latter is in large excess.—OWEN MORGAN.

Maize Flour.—Can any of your readers inform me if maize flour of fine quality will make good dessert biscuits, and whether, commercially speaking, it would pay to use such maize flour for said purpose, provided it could be prepared at a cost below that of wheaten flour.—A. K.

Manufacture of Soda Crystals.—Permettez moi d'avoir recours à votre obligeance habituelle pour me renseigner si possible sur le sujet suivant. Les usines de cristaux de soude Anglaises peuvent-elles fabriquer en été, et dans ce cas vouloir bien indiquer quel est le procédé employé pour obtenir une température assez basse, afin que la cristallisation puisse opérer.—P. G. CLAVEL.

Notes on the Utilisation of Sewage.—(From the “Report of the Main Drainage Committee for 1864,” vol. 487).

4063. (To Mr. Rawlinson.) The river Aire, which passes through Leeds and Bradford, is stated to be as bad as the Medlock; is that the case?—It is very foul.

4064. I believe the mud which is deposited in that stream is raised up by the floods, when they come down, and stinks and putrefies for a long way down the river?—It is so. The facts appear to be these, that in those rivers in Manchester, the sewage matter combines in some way with the subsoil; and fermentation takes place; you see the gas rise up in a bubble, and a mass of scum with it which cakes on the surface. You might skim the Bridgewater Canal at Manchester, and cleanse it completely every four and twenty hours; and this process of putrefaction with the subsoil takes place, and raises this scum, and again cakes and covers the surface.

4074. (To Mr. Rawlinson.) Then if it were remunerative to remove the matters of the cesspools to the land in former days by means of carts, will it not be still more remunerative in these days to remove it by means of suspension in water through mains, and with pumping engines?—There is no doubt about it; you can pump by those engines in the Lambeth works, which stand almost opposite this house, I believe, above 80,000 gallons 100 feet high, at a working cost (including coals, tallow, and wages) of 1s., and you would lift sewage on a large scale for the same money.

4104. (To Mr. Rawlinson.) In the case of Edinburgh, is not that a mode of application that will not be adopted at present by any town that commenced works afresh?—In Edinburgh they have the sewage for nothing; they have it entirely their own way: it has been applied to some of those meadows above 200 years, and this fact has been very useful as showing that land will continue to utilise it for a great length of time. Putrid town sewage has been applied at Edinburgh for above 200 years to the same portion of land, and from that down to the present time, the same land has given off a beneficial crop, and it is not proved to have been prejudicial to the health of the district. But it is applied rudely in large open carriers in which the sewage is floated along, and it is in those open carriers, where putridity continues from the scum and sediment on them, that you have the nuisance and the stench which has been referred to, and not from the irrigated area where the growing plants exist.

4209. (To Mr. Rawlinson.) Would your experience lead you to say that no such nuisance need really be occasioned?—I am satisfied that if this room were a grass-plot, you might irrigate it every morning and not have any perceptible smell from it within half an hour after irrigation.

4210. But if there were a perceptible smell for half an hour after, would not that be a nuisance that would justly be complained of?—It might be, but even that evanescent smell might be very cheaply got rid of by using a disinfectant.

4211. At what point in the system could you use a disinfectant?—Immediately before pumping. The sewage of Carlisle has been for four or five years used upon the meadows which are bounded by the river Eden, and Mr. McDougall, who is the patentee of a disinfecting fluid, does use it before the sewage water goes on to the land, and I understand that there is no perceptible smell at all from it.

4212. Do you know whether there is much expense attending the use of that disinfecting fluid?—Not very much.

4213. (To Mr. Rawlinson.) Could the use of such a fluid be very easily and practically applied to the whole of the sewage of London?—I believe that he applied his disinfectant during that very hot summer in 1859 to a portion of the district of London, and I think that the calculations as to the expense have shown us that you may use a disinfectant of that kind, varying from lime at £1 per 1,000,000 gallons up to perchloride of iron at £3 per 1,000,000 gallons, and the effect would be completely to destroy the smell for a time, and if you applied the sewage to land at once, the effect would be effectually to destroy all smell.

THE CHEMICAL NEWS.

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ON THE AMOUNT OF EXHAUSTION OBTAINABLE BY SPRENGEL'S MERCURIAL AIR-PUMP.

By W. F. DONKIN, M.A.

IN the early part of the year 1870 I made a series of experiments with the object of ascertaining the limit of the exhaustion attainable by means of the Sprengel pump. The pump used was similar in construction to that described by Mr. McLeod in a paper on the determination of the gases in water (*Journ. Chem. Soc.*, N.S., vol. vii., p. 311), including the syphon-tube, or "air-trap," interposed between the funnel and the fall-tube.

The method used consisted in—(1) exhausting a glass vessel, to which was attached a capillary tube sealed at the end; (2) letting mercury run into the vessel, so as to enclose all the residual air in the end of the capillary tube; (3) measuring the volume of this residual air, and comparing it with that of the vessel exhausted. The vessel used was a pipette of 50 c.c. capacity, one end of which was drawn out to a fine capillary tube and sealed, and the other end adapted to the pump. In the earlier experiments the vessel used was a bulb, which was sealed off after the exhaustion, and the end broken off under the surface of mercury. There was reason, however, to believe that air was carried in by the violent rush of the mercury, particularly if the end of the glass tube was broken against the bottom of the vessel containing the mercury; at any rate there was no proof that this was not the case; and therefore in all the subsequent experiments a neat device was made use of for introducing the mercury which was suggested to me by Mr. McLeod, and which consisted in closing the bottom of the fall-tube of the pump after the exhaustion, while the pipette was still attached to its upper end, so that the mercury was driven up into the pipette without any chance of carrying in air along with it. The end of the capillary tube was then broken off so as to enclose the residual air by a short column of mercury. Care was taken that the closed end of the capillary tube should be above the level of the mercury in the funnel of the pump, so that on breaking it off the column of mercury was driven a little further into the capillary tube. The two ends of the column being thus in the same condition as regards capillarity, no error through alteration of volume of the enclosed air from this cause could occur.

The next operation was to measure the volume of the enclosed air; and, since in the more complete exhaustions it was barely visible to the naked eye, the only chance of doing this with any approach to accuracy was to measure it under a microscope with a micrometer. For this purpose the little piece of tube was mounted on a slide in Canada balsam, the open end being left exposed to the air, and the length and diameter of the part of the tube enclosing the air was carefully measured. The micrometer used reads to 1-20,000th of an inch, and thus gave the results in cubic inches. These were converted into cubic centimetres by multiplying by the constant 16.386; so that if l and r are the length and radius of the part of the tube enclosing the air, its volume in cubic centimetres is $16.386 \times l\pi r^2$, and the fraction representing the exhaustion attained (the capacity of the pipette being 50 c.c.) is—

$$\frac{16.386 \times l\pi r^2}{50}$$

The pipette was attached to the pump by means of a short and rather thick piece of black india-rubber tubing, and the joint was surrounded by glycerin.

The experiments were made with the apparatus arranged in four different ways, with the object of ascertaining—(1) whether the above joint is a satisfactory one, and (2) whether the air-trap has any effect in increasing the amount of exhaustion.

In order to decide the first point, several experiments were made after removing the air-trap altogether, (a) with the india-rubber joint, (b) with the pipette sealed hermetically on to the top of the fall-tube.

In the first series (a), consisting of five experiments, the exhaustion attained appeared to improve successively, although the time occupied and the quantity of mercury used was approximately the same in each case, the fractions obtained varying from 1-229,300th to 1-10,770,000th. The reason of this probably lies in the fact that the same piece of india-rubber was used as a connector in all the experiments, and that the gases originally occluded in it got gradually pumped out.

A few exhaustions were now made (series b) after removing the india-rubber, and sealing the pipette on to the pump. The lowest fraction obtained was 1-15,330,000th, which is rather lower than the best of those in series a. It appears then that, if the air-trap is not interposed, a well-used india-rubber joint immersed in glycerin is as good a means as any for connecting vessels to be exhausted with the pump.

In order to decide the second point, viz., the value of the air-trap, two more series of experiments were made after replacing the air-trap—(c) with the same india-rubber joint as before; (d) after sealing the pipette again on to the pump. The best exhaustion obtained in series (c) was represented by 1-21,428,000th, and those in series (d) by the fractions 1-211,866,000th, 1-308,260,000th, and 1-937,920,000th.

From this it is evident that, so long as an india-rubber joint is used, the air-trap has but little effect in increasing the amount of exhaustion obtained; but that, when the pipette is sealed on to the pump, it is the air-trap which makes all the difference, the exhaustions becoming much more perfect. The air-trap is, in fact, an arrangement by which the mercury is made to pass through a vacuous space before reaching the pump. The mercury which has been in contact with the air appears to carry with it, possibly in solution, a small quantity of air which it will give up into an empty space, and if this space is the vessel to be exhausted, it is plain that the exhaustion cannot be carried beyond a certain limit; whereas, when the mercury has passed through a preliminary vacuum, where it can leave its dissolved or adherent air, there appears to be no definite limit to the exhaustion attainable, the difference in the three experiments (series d) depending on the length of time during which the pump was in action. In the last of them, for example, the mercury was allowed to run for at least an hour at the rate of about two drops per second, after the exhaustion was apparently complete.

In the case of the small volumes represented by the three last fractions, the probable errors of measurement become relatively large, and they are further increased by the fact that the volumes are not cylindrical. When a very fine capillary glass tube is sealed by momentary exposure to the edge of a flame, as was the case in all the above experiments, the interior form of the sealed end is nearly that of a pin's point, or (in section) the bows of a ship with very fine lines. In the three last experiments the mercury was driven quite into the pointed part of the tube, and in the last was more than half way up it. Now, assuming the longitudinal curvature of the sides to be circular, the volume of such a solid, from the apex to the base of the conical part, is about 0.42 of its circumscribing cylinder. This correction was applied in each case except the last, where the volume was taken as that of a cone, from which it did not appreciably differ, and was therefore one-third of the circumscribed cylinder.

As an example of the mode of calculation, the numbers obtained in the experiment from series c may be given:—

Length of bubble = 0.0705 inch.

Radius of tube = 0.0008 ,,

 $\therefore r^2 = 0.00000064.$

$$\frac{l\pi r^2 \times 16.386}{50}$$

$$\log. 0.0705 = \bar{2}.8481891$$

$$+\log. r^2 = \bar{7}.8061800$$

$$+\log. \pi = 0.4971500$$

$$+\log. 16.386 = 1.2144730$$

$$\hline \bar{6}.3679921$$

$$\log. 50 = 1.6989700$$

$$-\log. \text{numerator} = \bar{6}.3679921$$

$$\hline 7.3309779$$

$$n = 21,428,000.$$

and the fraction is—

$$\frac{1}{21,428,000}$$

In this experiment, the diameter of the tube was taken as 0.0016 inch. Now, if the reading had been taken as 0.00165 inch, the radius would have been 0.000825 inch, and the fraction expressing the exhaustion 1-20,150,000th. The difference, however, between the above readings was clearly perceptible, and there was no doubt that the smaller one was the most accurate.

A similar alteration in the readings obtained in the last experiment of series (d) causes relatively a much larger alteration in the final result, the fraction in this case becoming 1-836,610,000.

It appears, then, from these experiments that the Sprengel pump may be made to give an exhaustion down to 1-10,000,000th in its simplest and most convenient form, viz., without an air-trap, and with an india-rubber joint immersed in glycerin; but that, if a very complete exhaustion is required, the air-trap must be used, and the vessel to be exhausted must be sealed hermetically on to the pump.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 116).

SECTION V.—CALCULATION OF THE RESULTS.

THE succeeding results must not be regarded as embodying all the attempts to determine the atomic weight; for, as stated in the preceding section, many of the apparatus were broken at various stages of the operation. The calculations, however, serve to illustrate the weighings which came to a successful issue.

For the accurate determination of the weighings, it will be seen that it is necessary to ascertain the density of the ordinary atmosphere at the place where the weighings are made. Ritter has deduced from Regnault's observations that in Paris, lat. $48^\circ 50' 14''$, at 60 metres above the level of the sea, a litre of dry atmospheric air at 0° C. and 760 millims. pressure weighs 1.2932227 grms. It is well established that, if G represents the force of gravity at the mean level of the sea in lat. 45° , the force of gravity in lat. λ at the mean level of the sea = $G(1 - 0.0025659 \cos 2\lambda)$.

The force of gravity in a given latitude at a place on the surface of the earth at a height, z , above the mean level of the sea—

$$= \left\{ 1 - \left(2 - \frac{3c'}{2c} \right) \frac{z}{r} \right\}$$

multiplied by the force of gravity at the level of the

sea in the same latitude, r being the radius of the earth = 63966198 metres, c its mean density, and c' the density of that part of the earth which is above the mean level of the sea; and, if the ratio $c':c$ be taken as 5:11, then—

$$2 - \frac{3c'}{2c} = 1.32 \text{ nearly.}$$

Continuing the reasoning, Professor Miller has shown that a litre of dry atmospheric air, containing the average amount of carbonic acid, at 0° and 760 millims. pressure, at the height z above the mean level of the sea in lat. λ , weighs in grammes—

$$1.2930693 \left(1 - 1.32 \frac{z}{r} \right) (1 - 0.0025659 \cos 2\lambda).$$

It has been shown by Regnault and others that, between 0° and 50° , the ratio of the density of air at 0° to its density at t° is $1 + 0.003656t$, and that the density of the vapour of water is 0.622 of that of air. Therefore the weight in grammes of a litre of air will be—

$$\frac{1.2930693}{1 + 0.003656t} \cdot \frac{b - 0.378v}{760} \left(1 - 1.32 \frac{z}{r} \right) (1 - 0.0025659 \cos 2\lambda),$$

where t is the temperature of the air, b the barometric pressure, v the pressure of the vapour (of water) present in the air, both expressed in millimetres of mercury at 0° , z the height above the mean level of the sea, λ the latitude. My laboratory at Mornington Road, Regent's Park, where the atomic weight of thallium was determined, is in lat. $51^\circ 32' 6''$, at a height of 35.05 metres above the mean level of the sea. The expression consequently becomes—

$$\frac{1.2930693}{1 + 0.003656t} \cdot \frac{b - 0.378v}{760} (0.99999289815) (1.0005802549).$$

As a litre is the volume of 1000 grms. of water at its maximum density, the division of this expression by 1000 gives the ratio of the density of air to the maximum density of water. By the addition of the logarithm of $b - 0.378v$ in millimetres to $\log. A_t$ we obtain the logarithm of the ratio of the density of air at t° to the maximum density of water.

TABLE A.—Calculated for Mornington Road, Regent's Park.

t .	$10 + \log. A_t$.	Diff.	t .	$10 + \log. A_t$.	Diff.
			15	4.207868	
0	4.231055				1502
		1585	16	4.206366	
1	4.229470				1498
		1579	17	4.204868	
2	4.227890				1492
		1574	18	4.203376	
3	4.226317				1487
		1567	19	4.201889	
4	4.224750				1483
		1563	20	4.200406	
5	4.223187				1477
		1556	21	4.198925	
6	4.221631				1471
		1551	22	4.197458	
7	4.220980				1468
		1545	23	4.195990	
8	4.218535				1462
		1540	24	4.194528	
9	4.216995				1457
		1535	25	4.193071	
10	4.215460				1452
		1529	26	4.191618	
11	4.213931				1447
		1524	27	4.190171	
12	4.212407				1443
		1518	28	4.188728	
13	4.210889				1438
		1513	29	4.187290	
14	4.209376				1433
		1508	30	4.185857	
15	4.207868				

* A Paper read before the Royal Society June 20, 1872.

TABLE B.—Values of $0.378 \times \frac{2}{3}vt$, where vt is the maximum pressure of vapour at the temperature t , in millims. of mercury at 0° , according to Regnault's observations.*

t .	0.	1.	2.	3.	4.	5.	6.	7.	8.	9.
0	1.16	1.17	1.18	1.18	1.19	1.20	1.21	1.22	1.23
1	1.25	1.25	1.26	1.27	1.28	1.29	1.30	1.31	1.32
2	1.34	1.35	1.36	1.37	1.37	1.38	1.39	1.40	1.41
3	1.43	1.44	1.45	1.46	1.47	1.48	1.49	1.50	1.51
4	1.54	1.55	1.56	1.57	1.58	1.59	1.60	1.61	1.63
5	1.65	1.66	1.67	1.68	1.69	1.70	1.72	1.73	1.74
6	1.76	1.78	1.79	1.80	1.81	1.82	1.84	1.85	1.86
7	1.89	1.90	1.91	1.93	1.94	1.95	1.96	1.98	1.99
8	2.02	2.03	2.05	2.06	2.08	2.09	2.10	2.12	2.13
9	2.16	2.17	2.19	2.21	2.22	2.24	2.25	2.27	2.28
10	2.31	2.32	2.34	2.35	2.37	2.39	2.40	2.42	2.44
11	2.47	2.48	2.50	2.52	2.53	2.55	2.57	2.58	2.60
12	2.64	2.65	2.67	2.69	2.71	2.72	2.74	2.76	2.78
13	2.81	2.83	2.85	2.87	2.89	2.91	2.93	2.94	2.96
14	3.00	3.02	3.04	3.06	3.08	3.10	3.12	3.14	3.16
15	3.20	3.22	3.24	3.26	3.28	3.31	3.33	3.35	3.37
16	3.41	3.43	3.46	3.48	3.50	3.52	3.54	3.57	3.59
17	3.63	3.66	3.68	3.71	3.73	3.75	3.78	3.80	3.82
18	3.87	3.90	3.92	3.95	3.97	4.00	4.02	4.04	4.07
19	4.12	4.15	4.17	4.20	4.22	4.25	4.28	4.30	4.33
20	4.38	4.41	4.44	4.47	4.49	4.52	4.55	4.58	4.61
21	4.66	4.69	4.72	4.75	4.78	4.81	4.84	4.87	4.90
22	4.95	4.99	5.02	5.05	5.08	5.11	5.14	5.17	5.20
23	5.26	5.30	5.33	5.36	5.39	5.43	5.46	5.49	5.52
24	5.59	5.62	5.66	5.69	5.73	5.76	5.80	5.83	5.87
25	5.93	5.97	6.01	6.04	6.08	6.12	6.15	6.19	6.22
26	6.30	6.34	6.37	6.41	6.45	6.49	6.53	6.56	6.60
27	6.68	6.72	6.75	6.79	6.83	6.87	6.91	6.95	6.99
28	7.08	7.12	9.17	7.21	7.25	7.29	7.34	7.38	7.42
29	7.51	7.55	7.59	7.64	7.68	7.73	7.77	7.82	7.86
30	7.95	8.00	8.04	8.09	8.14	8.18	8.23	8.28	8.37

* *Annales de Chimie*, 1845, 3me série, tome xv., p. 138.

These logarithms, when increased by 0.000030, agree with those employed by Professor Miller in his determination of the value of the new standard pound (see *Phil. Trans.* for 1856) when working in the cellar under the Mineralogical Museum at Cambridge, in lat. $52^\circ 12' 18''$, about 8 metres above the mean level of the sea; increased by 0.000002 they can be used in reducing weighings in Somerset House, lat. $51^\circ 30' 40''$, 29.56 metres above sea-level; or diminished by 0.000102 for weighings made in Paris.

We have next to consider the influence exerted by the hygrometric state of the atmosphere, or, in other words, the influence of the vapour of water suspended in the atmosphere. It is clear that the moist air is nothing more than a mixture of v cubic inches of dry air at t° under a pressure *minus* that of the vapour, and of v cubic inches of vapour at t° and the pressure resulting from the hygrometric condition. Biot, Regnault, and Bianchi have ascertained that the pressure of vapour in an ordinary dry room is two-thirds of the maximum pressure due to the temperature.

(To be continued.)

NOTE ON A

NEW METHOD OF TAKING SPECIFIC GRAVITIES, ADAPTED FOR SPECIAL CASES.

By E. SONSTADT.

THE method to be described I devised some years ago for the purpose of quickly and accurately comparing together the specific gravities of different specimens of certain alkali salts, and especially chloride and sulphate of potassium. I have found the method very convenient, not only in these cases, but also whenever wanting to know the sp. gr. of any mineral not so heavy as to sink in such a liquid as could be conveniently made and used.

For taking the sp. gr. of specimens of chloride of potassium and of potassium alum I used iodide of ethyl, which,

having been prepared from commercial "methylated spirits," contained a few per cents of iodide of methyl, and had a sp. gr. of about 2° . This was diluted by bisulphide of carbon* until, at the temperature of the experiment, a standard specimen of the chloride of alum, prepared with great care and of proved purity, neither rose nor sank when immersed in the liquid. The crystal could then be made to swim or sink by a very slight alteration in the temperature of the liquid, such as might be produced by holding the bottle a moment in the hand, or by placing it in a cooler part of the room. When the liquid is standardised, say, to pure chloride of potassium, any specimen of that salt may at once be examined by dropping it into the liquid still containing the standard crystal. If the specimen contain even only a trace of sodium, rubidium, or cesium, it will be known by its greater specific gravity, and consequent tendency to sink in the liquid that supports the pure specimen. The difference may be only just perceptible, or it may be considerable. Slight differences may be quantitatively determined by observing through how many degrees of temperature the liquid must be cooled to bring the heavier specimen into equilibrium. Larger differences require for their determination a series of bottles containing liquids so adjusted that the intervals between may be filled up by moderate changes of temperature. If the crystal examined is heavier at one end or side than at the other, this difference will be shown by the heavier end always being below after coming to rest, however often it may be shaken up. This is remarkably the case with crystals of chloride of potassium prolonged in one direction. The end last formed I have found to be specifically the heaviest. When an alum is examined, it will be found that the presence of any trace

* Chloroform may be used as a diluent instead of bisulphide of carbon, but less advantageously. In either case, the liquid gains in sp. gr. by exposure to the air, owing to the greater volatility of the diluent; but the change is much more rapid when chloroform is used than when, as recommended in the text, bisulphide of carbon is used. The liquid soon becomes coloured by separation of iodine, but this may be prevented by keeping in it magnesium or copper wire, or filings.

of ammonia lowers the sp. gr., while the presence of sodium, rubidium, or caesium increases it. Sodium appears to be always present in potassium alum crystallised out of a liquid containing much of any salt of sodium; nor can the sodium be completely separated by one re-crystallisation. When potassium alum is perfectly pure, I did not find the sp. gr. of the crystals vary in the least under different conditions of formation. In one instance seven re-crystallisations gave crops from which specimens were selected, and proved to be of perfectly equal sp. gr. Yet, if a trace of rubidium is contained in an otherwise pure potassium alum, so minute that the spectroscope fails to detect it in the ordinary gas flame, and only shows the principal rubidium lines in the flame of hydrogen burning in air, that specimen of alum will be distinguishable from the pure salt when crystals of the two are placed together in a well-adjusted liquid. This fact illustrates the extreme delicacy of this method of comparing specific gravities.

In testing the sp. gr. of sulphate of potassium and of many minerals, I have used a solution in water of pure iodide of potassium and pure mercuric iodide. To form this solution, a saturated solution is taken at common temperature of iodide of potassium, and as much mercuric iodide is stirred up in it as it will dissolve. It will then dissolve more iodide of potassium, then more mercuric iodide, and so forth. The iodides dissolve very slowly at the last, and as it is best not to accelerate the solution by the application of heat, considerable time must be allowed when a liquid of maximum strength is required. The solution, after filtering, is fit for use, and may be obtained, without danger of its crystallising above zero, of sp. gr. 3.085 at 12° C. This liquid is transparent, very mobile, filters easily, is of an amber colour, gives no precipitate on addition of water, and does not readily lose or gain water on long exposure to the atmosphere. When diluted to the sp. gr. of sulphate of potassium, it has scarcely any solvent action on that salt, which, however, if kept in it for a month or more, becomes roughened. Practically, over any moderate time, it has no action. The solution undergoes no perceptible chemical change by free exposure to the air over many months. It may be diluted to any extent, and then concentrated by heat, without injury.

When this liquid is diluted so that quartz will just float on it, any mineral heavier than quartz will of course sink. As many minerals closely resemble quartz in external characters, and can be distinguished more readily by their sp. gr. than in any other way, this method of testing the sp. gr. furnishes a very quick and certain means of discrimination. A small bottle of the liquid, containing, say, half an ounce, and carried in the waistcoat pocket, would enable the mineralogist to make a great many examinations on his walks, as to whether the specimens he examined were above or below a certain sp. gr. The smallest distinctly visible particle of a mineral is enough for a determination. After the bottle became clogged with specimens, the liquid might be poured out for further use, and if the washings were added, and the whole concentrated, there need be no sensible waste.

I have thought that perhaps this liquid might be found serviceable for separating diamond-dust, or small diamonds and other gems, from quartz-sand.

New Hydrocarbon of the Stilben Series.—G. Goldschmiedt and E. Hepp.—Dimethyl-stilben was obtained both by the reduction of ditolyl-trichlor-ethan with zinc-powder, and by distilling ditolyl-monochlor-ethan. It forms iridescent leaflets which melt and sublime at 176° to 177°. It boils above 300°, and has the composition $C_{16}H_{16}$. It is remarkably analogous to stilben. It is readily soluble in sulphide of carbon, ether, and boiling alcohol, but less easily than stilben.—*Ber. d. Deuts. Chem. Ges. zu Berlin.*

ON THE METHODS OF ANALYSING WATER.*

By FERD. TIEMANN.

THE author treats of the determination of nitric acid, for which we have—

I. *Methods Founded on the Conversion of the Nitric Acid in an Alkaline Solution into Ammonia.*

Schulze was the first to establish a process upon this principle, followed by Wolf, Harcourt, and Siewert. The method and apparatus have been modified by Bunsen, Chapman, and others. Schulze reduces with platinised zinc; Wolf, Harcourt, and Siewert with zinc and iron-filings; Bunsen with a spiral of zinc and iron; and Chapman with aluminium-foil. Wolf points out the necessity of conducting the reduction in a cold solution. Frühling maintains that the methods founded on this principle are inaccurate in presence of organic matter. Finkener infers from his experiments that all the nitric acid is decomposed. The author passes an unfavourable judgment upon all these methods.

II. *Determination of Nitric Acid by Reduction to Nitric Oxide, and Re-Transformation into Nitric Acid.*

This reaction was first applied by Schlösing to the determination of nitric acid.

1. *Method of Schlösing.*—The water under examination is concentrated to a small bulk in a flask fitted with an escape-tube, and every trace of air expelled out of the apparatus. After stopping up the tube, it is allowed to cool, and by aid of the vacuum thus produced within, first a strong solution of protochloride of iron, and afterwards traces of concentrated hydrochloric acid, are drawn up into the flask. The nitric oxide produced by their action is expelled by a gradual rise of temperature, and received in a cylindrical glass vessel drawn out to a point, which has been previously filled with mercury and a little milk of lime, and inverted over mercury. As soon as all nitric oxide has been driven over, water is heated for some time to a boil in a second flask, likewise provided with a delivery-tube of caoutchouc. This tube is pushed over the point of the glass cylinder, the flame removed, the point broken, and the nitric oxide is allowed to pass over into the flask. After the last traces of this gas have been driven out of the collecting-receiver by a current of pure hydrogen, which is transferred to the flask in a similar manner, the latter is allowed to absorb pure oxygen as long as red fumes are produced. The caoutchouc tube, and consequently the flask, is closed by a pinchcock, and, after the lapse of twenty minutes, the nitric acid, reproduced by means of the nitric oxide, oxygen, and water, is titrated with dilute soda-lye. This process is considered accurate according to the unanimous report of the most experienced analysts. It requires, however, great skill and appliances not always procurable.

Reichardt, after he had satisfied himself that the portions of the nitric oxide absorbed by soda-lye were imperceptibly small and might be safely neglected, replaced the mercury by a solution of soda. He provides the gas-developing vessel with a stopper pierced with two holes, through which pass two bent glass tubes with caoutchouc connectors and pinchcocks—one for the admission of the chloride of iron and hydrochloric acid, and the other to connect with the soda-receiver and to deliver the nitric oxide generated. The receiver consists of two tall narrow bottles, the first of which has a stopper with a triple perforation, and is completely filled with soda-lye. The nitric oxide is received in the upper part of this bottle. Through two of the holes in the stopper pass bent fine glass tubes,

* Abstract of a Paper from *Ber. d. Deut. Chem. Ges. zu Berlin.*

the first of which is connected in the course of the operation with the delivery-tube of the generating-flask; the second forms the communication between the soda-lye in the collecting-bottle with that in the second narrow bottle. These two tubes pass down nearly to the bottom of the bottle. A slightly bent glass tube in the third perforation is cut off level with the bottom of the cork, is provided with an india-rubber closure, and serves to transmit the disengaged nitric oxide into Schlösing's regenerating-bottle. This process is much employed, and is very convenient; but the results are slightly below the truth. 10 to 15 c.c. of an almost saturated solution of protochloride of iron are enough for 1 to 40 milligrms. of nitric acid.

CHEMISTRY APPLIED TO THE DETECTION OF ADULTERATION.

By ALFRED H. ALLEN, F.C.S.,

Public Analyst for the Borough of Sheffield; Lecturer on Chemistry at the Sheffield School of Medicine.

IN accordance with the request of the Editor of the CHEMICAL NEWS, I have undertaken the compilation of a series of articles on the detection and estimation of adulteration of food, &c., regarded more especially from a chemical point of view.

The microscopical examination of food has been dealt with so fully by Hassall, and by Mr. Bell in his recent lecture before the Chemical Society, that there is no occasion to enter into the matter again, especially as the microscopic appearance of substances is not liable to change or improvement, like the chemical processes for their detection and estimation.

The very great want of definite knowledge on the subject, and of a more systematic method of procedure, has doubtless been the cause of some of the recent lamentable discrepancies in the results of public analysts, and there seems to be a demand on the part of many chemists for further information respecting the processes adopted by their fellow analysts.

In the following articles I propose to give, in a condensed form, the results of previous workers, and in some instances to supplement these by the conclusions derived from my own observation and experience. Of course the articles must be largely compiled from former papers, but it is hoped that they will be found more useful and convenient than a continual reference to the originals.

I. Coffee and Chicory.

Coffee and chicory can be conveniently considered together, as their adulterations are to a great extent similar, and the frequency of their admixture renders it difficult to treat of either without reference to the other.

It is a very prevalent idea that the admixture of chicory with coffee is a decided improvement, and *de gustibus non est disputandum*; but the low price of chicory as compared with coffee is a strong temptation to increase the proportion of chicory to an undue extent. Certainly, the unacknowledged addition of chicory to coffee must be considered an adulteration, but there can be no objection to the mixture being sold, provided the purchaser does not purchase it for pure coffee.

Chicory (*Cychorium intybus*) belongs to an entirely different botanical order from coffee, being closely allied to *Taraxacum* (dandelion), which it resembles in its therapeutic effects. Chicory is entirely destitute of the alkaloid caffeine of caffeic acid, and of the essential and fixed oil contained in coffee (a little fat is added to chicory during the process of roasting), and appears to possess no stimulating or other valuable dietetic properties.

The infusion of coffee is brown, but perfectly clear, and strikingly different in appearance from that given by

chicory, which is turbid and of a disagreeable bitter flavour. It seems probable that coffee drinkers, who like the dark colour and bitter taste which an admixture of chicory imparts, might obtain the same results in a cheaper, and possibly healthier, way, by using burnt sugar, which is said to be sold to coffee dealers and coffee-house keepers under the name of "black-jack."

Good coffee is not hygroscopic, while chicory is highly so, and mixtures containing it show the same character more or less. Squeezed between the fingers, genuine coffee does not cohere, but mixtures containing chicory usually cake together. When moistened with water the grains of coffee remain hard for a considerable time, while the usual adulterants soften immediately.

A preliminary examination of coffee for admixture is best made by gently strewing the powder upon the surface of cold water. The oil contained in coffee prevents the particles from being readily wetted by the water, thus causing them to float. Chicory, burnt sugar, &c., contain no oil, and their caramel is very quickly extracted by the water, with production of a brown colour, while the particles themselves rapidly sink to the bottom of the water.* On stirring the liquid, coffee becomes tolerably uniformly diffused without sensibly colouring the water, while chicory and other sweet roots quickly give a dark brown turbid infusion. Roasted cereals do not give so distinct a colour.

Under the microscope, the presence of chicory is readily recognised by the peculiar dotted character of the vessels, often occurring in bundles, and by the characteristic appearance of the large cells. The presence of burnt sugar is best recognised by moistening the sample with water and observing it with a low power. If the brown colouration appears to be concentrated round small, dark-coloured, hard, shiny particles, the presence of extraneous caramel may be considered certain. Chicory and other roasted sweet roots contain caramel as a normal constituent, so the chemical tests are valueless for indicating its origin.

If roasted cereals or leguminous seeds be present, the starch corpuscles will still be recognisable, though often so altered as to render it impossible to determine the kind of seed from which they were derived.

The microscope affords an efficient means of detecting most of the adulterants of coffee and chicory, but for their estimation recourse must be had to other means, and even these are not very satisfactory, the determinations possible by known methods amounting at best to mere approximations.

According to Messrs. Graham, Stenhouse, and Campbell,† the proportion of sugar existing in raw and roasted coffee-berries is:—

	Sugar, per cent.	
	Raw.	Roasted.
Highest amount	7.78	1.14
Lowest amount	5.70	—
Average of twelve specimens grown in different places }	6.97	0.26

The sugar in the raw berries is cane sugar, but it appears to exist in some peculiar state of combination, as it does not yield caramel by the roasting of the berries.

The percentage of sugar in chicory and other sweet roots has also been determined by the above chemists (by fermentation). (See table at top of next column).

Messrs. Graham, Stenhouse, and Campbell found that the depth of colour of the liquid obtained by infusing coffee and its usual adulterants in 2000 times their weight of boiling-water varied remarkably, caramel giving about seven times, and chicory about three times, as deep a colour as coffee. The test, in my opinion, is of but limited value, as coffee itself gives a brown colour, and therefore

* If a separating funnel be used for the above test, the chicory, &c. may be readily let out at the lower end and examined separately under the microscope.

† *Journ. Chem. Soc.*, 1857, p. 33.

		Sugar, per cent.	
		Raw.	Roasted.
Foreign chicory	.. ..	23.76	11.98
Guernsey	.. ..	30.49	15.96
English	.. ..	35.23	17.98
„	„ (Yorkshire)	32.06	9.86
Mangold-wurzel	.. ..	23.68	9.96
Carrots (ordinary)	.. ..	31.98	11.53
Turnips	.. ..	30.48	9.65
Beet-root (red)	.. ..	24.06	17.24
Dandelion-root	.. ..	21.96	9.08
Parsnips	.. ..	21.70	6.98

a moderate adulteration cannot be detected, especially as different samples of coffee were found to vary between 183 and 143 in tinctorial power, as compared with caramel at 1000.

Caramel itself is not a definite substance, and different samples vary much in tinctorial power.

Messrs. Graham, Stenhouse, and Campbell found the density of infusions of coffee and its adulterants a valuable criterion. The solutions were made by treating the powder of the roasted substance with ten times its weight of cold water, and then raising the liquid to the boiling-point and filtering through paper, when the infusions had the following densities at 60° F.

Spent tan	.. ..	1002.14
Lupin-seed	.. ..	1005.70
Acorns	.. ..	1007.30
Peas	.. ..	1007.30
Mocha coffee	.. ..	1008.00
Beans	.. ..	1008.40
Neilgherry coffee	.. ..	1008.40
Plantation Ceylon coffee	.. ..	1008.70
Java coffee	.. ..	1008.70
Jamaica coffee	.. ..	1008.70
Costa Rica coffee	.. ..	1009.00
„	„	1009.05
Native Ceylon coffee	.. ..	1009.00
Brown malt	.. ..	1010.90
Parsnips	.. ..	1014.30
Carrots	.. ..	1017.10
Bouka..	.. ..	1018.50
Yorkshire chicory	.. ..	1019.10
Black malt	.. ..	1021.20
Turnips	.. ..	1021.40
Rye-meal	.. ..	1021.60
English chicory	.. ..	1021.70
Dandelion-root..	.. ..	1021.90
Red beet	.. ..	1022.10
Foreign chicory	.. ..	1022.60
Guernsey chicory	.. ..	1023.20
Mangold wurzel	.. ..	1023.50
Maize..	.. ..	1025.30
Bread raspings..	.. ..	1026.30

This test furnishes valuable confirmatory evidence of the presence and probable proportion of sweet roots and cereals, but does not allow of the recognition of the leguminous seeds.

Neither chicory nor coffee contains starch, so, if any be present, it shows an admixture with some cereal or leguminous seed. If the sample be boiled with water and animal charcoal, starch may readily be detected in the cold filtered solution by the well-known blue colouration with solution of iodine.

Of course, the particular seed which has been added to the sample can only be ascertained with certainty when the process of roasting has left the microscopic characters of the starch almost unchanged, but when the adulteration is extensive valuable confirmatory evidence is afforded by the composition of the ash, as pointed out by Messrs. Graham, Stenhouse, and Campbell in the paper already referred to.

The percentage of ash yielded by genuine coffee should not exceed 4.5 per cent, and chicory should not give more

than 5.0 per cent of ash, and any proportion considerably in excess of these numbers may be regarded as indicating adulteration by mineral matter. If red ochre, Venetian red, or other ferruginous matter be present, the ash will have a reddish colour. The oxide of iron natural to coffee never reaches 1 per cent of the weight of the ash, and in chicory ash it varies from 3 to over 5 per cent.

The ash of coffee is remarkable for its almost complete freedom from silica, so that, even if 1 per cent of the ash remains insoluble in boiling hydrochloric acid, it is a proof of adulteration. Chicory ash, on the other hand, contains a large and very variable amount of silica, varying from 10 to 36 per cent of its weight. A considerable proportion of this exists in the form of actual sand; this will be left insoluble on treatment of the ash with hydrochloric acid, but, to render the whole of the silica insoluble, evaporation of the acid liquid to dryness, and re-solution, must be resorted to. Iron can be conveniently determined in the filtrate by one of the volumetric methods. A considerable quantity of the sample should be taken when it is intended to make these estimations.

Some years ago imitation coffee berries were manufactured of Stourbridge clay; these were mixed with the genuine berries, and roasted with them, when they absorbed some of the colouring matter and oil, and so remained a close imitation. On breaking such spurious berries, the colour would be seen to be principally on the exterior. Of course the fraud would be at once detected on the estimation of the ash and its contained silica.

In 1850, Messrs. Duckworth, of Liverpool, took out patent for moulding chicory into the form of berries.

As a rule I should recommend the use of the following method of examining coffee and chicory, the first three tests being always applied, and the others when further information is required:—

1. The cold-water test.
2. Examination of the sediment in cold water, and of the original sample, under the microscope.
3. Estimation of the ash and, if necessary, of its contained silica and iron.
4. Determination of the density of the aqueous infusion.
5. Ebullition of the sample with water and animal charcoal, and application of the iodine-test for starch to the filtered liquid when cold.

(To be continued).

PROCEEDINGS OF SOCIETIES.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

Ordinary Meeting, January 29th, 1874.

Dr. LUNGE, President, in the Chair.

THE PRESIDENT said, before proceeding to the business of the evening, he might read the following account, translated from a German newspaper of undoubted reliability:—

“In the Silesian village Lazisk, near Nicolai (county of Oppeln), the other day the following fearful accident took place. In a public-house there were sitting, among other visitors, several miners and a gamekeeper. The miners had just come from their work, and had still their leather satchels slung from their shoulders, in which they used to keep their smaller tools. Suddenly the gamekeeper observes smoke issuing from the satchel of one of the men, and whilst he stretches out his hand for it, to ascertain the cause, something explodes within the satchel with a tremendous noise. The miner is torn in several pieces; some parts of his body are hurled through the shattered ceiling, and the whole house is almost demolished. Most other persons present at the accident were more or less hurt. The before-mentioned gamekeeper lost an arm, and was so much injured that he died after a few days. The cause of the accident was found in this—that the miner

had put in his pocket eight dynamite cartridges prepared for blasting, and had put beside them his tobacco pipe, which was not quite smoked out, the spark of fire still present in the tobacco causing the explosion."*

Mr. PATTINSON said from his own experience he should very much doubt the freedom from stythe referred to by Mr. Berkley, and he was confirmed in this by a gentleman who had had considerable experience in the use of dynamite. He had also had the details of a recent fatal accident in Wales from the same gentleman, which threw some doubt on its great safety.

Mr. LOMAS offered a few remarks on the advantages of dynamite, and promised a more detailed communication at the next meeting.

Mr. FREIRE-MARRECO exhibited and described a series of slides illustrating the examination by polarised light of bees'-wax and its various adulterants.†

NOTICES OF BOOKS.

The Retrospect of Medicine. Edited by W. BRAITHWAITE, M.D., and J. BRAITHWAITE, M.D. Vol. lxviii., July to December, 1873. London: Simpkin and Marshall.

THE half-yearly volume before us, in addition to its usual survey of the progress of medical science, contains several articles no less interesting to chemists than to physicians.

The papers "On Sewage and Disease," "On a Pure Water Supply," "On the Dangers of Well-Water," the "Report of the Analytical Sanitary Commission on Disinfectants," "On the Dissemination of Zymotic Disease by Milk," "On the Origin of Typhoid by Infected Milk," and "On the Affectable and Infectable Susceptibility of Milk" enter deeply into questions which have been seriously debated this season, both in professional and non-professional circles, and on which we are far from having reached a satisfactory conclusion. To some of the above-cited papers we may, space permitting, take occasion to return.

Elementary Inorganic Chemistry: The Non-Metallic Elements. By RAPHAEL MELDOLA, F.C.S. London: Thomas Murby.

THIS volume belongs to "Murby's Science and Art Department series of Text-Books," edited by S. B. J. Skertchley, F.G.S. The author is described as of the Royal College of Chemistry and Science Training Schools, South Kensington. To say on elementary inorganic chemistry, within the compass of some 180 pages, anything at once novel, true, and important is not easy. The author, to do him justice, does not make the attempt. His object is distinctly stated. "This book, he tells us, 'makes no pretence to teach practical chemistry, but is intended rather as a companion to the student when attending the course of demonstrations prescribed by Dr. Frankland for the science classes undergoing preparation for the May examinations of the Science and Art Department.'" In other words, his object is to teach, not so much chemistry, as those views of chemistry which are at present in the ascendant at South Kensington. Let no one infer that we under-value the work on this account. We may, indeed, think art too long and life too short for a nomenclature of which "tetra-hydrogen calcium diphosphate" is a specimen; we may hold that, if a "graphic formula is nothing more than an artificial epitome of the reactions of a compound," the "epitome" is far harder to remember than a detailed state-

* The journals of Bourdeaux state that the manufactory of dynamite at St. Medard-en-Julle has just been completely destroyed by an explosion, the third that has taken place since its foundation, no trace of the workshops remaining. (*Am. Chem.*, iv., 280, Jan., 1874.)

† A compound eye-piece of selenite and tourmaline was employed, but the appearances can hardly be described without engravings, which it is not considered worth while to give, as the experiments are only preliminary.

ment of the facts. Still, so long as a knowledge of such nomenclature and such formulæ is exacted from the student as an imperative condition, books like the one before us are needed, and must be carefully studied.

CORRESPONDENCE.

GREEN'S FUEL ECONOMISER.

To the Editor of the Chemical News.

SIR,—On perusing your CHEMICAL NEWS, vol. xxix., p. 69, we observe an article relating to "Fuel Economisers" now being exhibited at Manchester (Peel-Parke), and wish to draw your special attention to a paragraph in reference to our fuel economiser, which is as follows:—"There is one serious objection—that is, if a pipe in the centre burst, it is not easy to get at it, and to replace it often involves a loss of several days." This we consider is a matter of great importance, and we think it only right and just, in order to protect our own interest, to state that our apparatus is so arranged that we can not only draw the centre pipe, but also any pipe that may require to be drawn, and replace it in a couple of hours without disturbing the brickwork, and not necessitating a loss of several days as you imagine. Moreover, we may state that ours is the only apparatus where this provision is made. We take the liberty of handing you one of our prospectuses, in which you will see a diagram showing a pipe partly drawn out.—We are, &c.,

EDWARD GREEN AND SON.

Phoenix Works, Wakefield,
March 12, 1874.

PINK AND WEBSTER'S "ANALYTICAL CHEMISTRY."

To the Editor of the Chemical News.

SIR,—A comparison of A. G. P.'s critique on this book in CHEMICAL NEWS, vol. xxix., p. 90, with the reply (p. 120) of Mr. Webster, will show that the latter has found fault with the trivial inaccuracies of his critic, but has neglected to answer, or even to understand, the real accusation brought against him. It is scarcely necessary to point this out to your readers, but perhaps you will allow me to state that a somewhat lengthy correspondence with Messrs. Pink and Webster has convinced me of their utter inability to admit themselves mistaken. A. G. P. may rest assured that the utmost he can achieve will be to draw from these two gentlemen a collection of letters of no earthly use except to raise a smile. Unfortunately there is a serious side to the subject. Some wretched students are certain to assimilate Pink and Webster's book, and will ultimately have to unlearn at least a portion of what they have learnt. That the book is lamentably deficient will be acknowledged by all who read it, except the authors; even they may see, though they may not confess, that a student examining so common a salt as hyposulphite of soda as an unknown substance could not possibly ascertain what it was if he worked only according to their instructions. This single instance shows the incompleteness of the book. As a specimen of its positive errors, look at the following extract from page 71:—

"Examination for the Inorganic Acids.

"To a neutral solution add BaCl_2 , and cover the end of the test-tube with a watch-glass. . . .

"Watch-glass becomes corroded—Presence of HF. . .

"Effervescence takes place—Indicating Presence of COHO_2 ."

For the present this is quite enough.—I am, &c.,

GEO. CHALONER.

Birkbeck Institution
March 16, 1874.

ARTIFICIAL INDIGO.

To the Editor of the Chemical News.

SIR,—I notice with interest a communication (CHEMICAL NEWS, vol. xxix., p. 110) by Dr. Phipson on the probable production of indigo from phenol-cyanine, and as I have for many years been interested in this subject, but too much engaged to follow it out carefully, perhaps you will allow me to reproduce in your journal a few remarks which I made in a paper read before the recent Pharmaceutical Conference at Bradford, and which resulted from facts observed during many years in the manufacture of ammoniacal salts, &c., from crude gas-liquor.

Referring to the various impurities found in gas-liquor, I remarked some of these principles have acid qualities, and adhere with such tenacity to the volatile alkali of the gas-liquor that they cannot be separated from it either by oxidation, distillation, or by detergent agents. For instance, we may separate the sulphur by a hydrated metallic oxide, then treat the filtrate with permanganate, and distil it two or three times, and we shall get a product sweet and brilliant; but, after standing a month in a white glass bottle, a deep indigo-blue deposit forms on the glass.

Twenty years ago I formed the opinion that this deposit is a true indigo resulting from a re-arrangement of the elements of the gas-tar and the ammonia, and subsequent discoveries as to the constituents of gas-tar confirm the impression. Note, for instance, the composition of phlorylic acid, $C_8H_{10}O$, and ammonia, NH_3 , and water, HO ; may we not admit the probability of indigo resulting thus?—

Phlorylic acid, $2C_8H_{10}O$ } = Indigo, $C_{16}H_{10}N_2O_3$, and H_{18}
Ammonia, $2NH_3$ } (evolved slowly during forma-
Water, $2HO$ } tion of blue deposit).

The tendency to form this blue deposit renders such liquor ammoniac unfit for pharmaceutical and some other purposes.

I shall be interested in any comments which these observations may elicit.—I am, &c.,

ALFRED PAYNE, F.C.S.

Ett'ngshall, Wolverhampton,
March 11, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, January 26, 1874.

Acetylen Liquefied and Solidified by means of the Electric Effluvia.—MM. Thenard.—The gas condensed very rapidly, 4 to 5 c.c. in a minute, appearing on the interior surface as a solid body of vitreous or horny look, very hard, and with the colour of wine. It is refractory to all solvents, even fuming nitric acid. It gave on analysis the elementary formula of gaseous acetylen.

Experimental Researches on the Coloured Rings of Newton.—M. Desains.—The lens is fixed, and the plane is moved by means of a micrometric screw, the thread of which is half a millimetre. The angular movement required to bring sixty consecutive rings into the central spot is 12.85° , and R is deduced $= 0.000594$ m.m., the light being that from a saline gas.

Direct Demonstration of the Equation $\int \frac{dQ}{T} = 0$ for every Cycle, Closed and Reversible.—M. Ledieu.—A thermo-dynamical paper.

M. Poncelet's Course of Applied Mechanics.—Gen. Morin.

Observations by Prof. Nordenskjöld in the Polar Regions.—(Continued).—This letter treats of the car-

bonaceous dust, along with metallic iron, found falling in these regions, the vast glaciers explored, and beds of fossil plants. The writer finds that the transformation of snow into ice shows an intermediate state in which the snow layer is changed into one of ice-crystals, forming hexagonal tables (like crystals of colourless apatite). A section of the lower part of a glacier presents the following layers.—(a) A layer of snow of varying thickness, consisting of very small detached grains rounded by friction against each other, and carried about with the least wind. (b) A more solid layer of small grains changed below into (c) a layer consisting almost exclusively of crystals; at the lower part of this layer the crystals are rounded more and more, and transformed gradually into (d) a layer of large round grains of small weight. The true ice is formed by compression of these grains. In the upper part it is very porous, but it becomes more and more solid.

Note on Magnetism.—M. Gaugain.—After noticing M. Jamin's observations on the distribution of magnetism in a soft iron bar having bobbins round its two extremities, the author recurs to the phenomena produced by detachment of an armature. He finds that the magnetisation obtained by means of a current of certain intensity may be increased by a current in the contrary direction. His procedure is as follows:—He passes a current of intensity $+I$ into the bobbins of an electro-magnet furnished with its armature, interrupts the current without detaching armature, passes a current in the opposite direction and of less intensity, $-i$, interrupts this current, detaches armature, then applies and detaches a number of times sufficient to bring the magnetism to the constant state. After this process the permanent magnetisation of the bar is found much stronger than if the current $+I$ circulated alone in the electro-magnet. The author theorises on this and some other related effects.

Theory of Flight of Birds.—MM. Planavergne. (Extract).—The authors state with reference to M. Marey's recent communication that they had already formulated the same principle, and they cite a passage proving this.

Certain Reactions of the Oxygen Compounds of Nitrogen.—M. Berthelot.—A thermo-chemical paper, unsuitable for abstraction.

Rupture of Magnetised Needles.—M. Bouty.—If a magnetic needle of recently hardened steel be broken through the middle one of two cases may occur. (1) If the needle is hardened sufficiently to break in the fingers like glass, the two halves are magnets of the same magnetic moment. (2) If the needle is softer, so that it bends several times before breaking, the two halves have unequal magnetic moment, and in a manner seemingly arbitrary. The following experiments were made with regard to this:—A regular steel needle, slightly hardened, is seized to the middle between two lead plates, the free extremity being grasped, is bent to and fro repeatedly till rupture; and the half thus bent is found to have less magnetic moment than the other half. Again, if one seize a similar needle with two pincers, at points very near its middle, and equally distant from it, the two halves after rupture have equal magnetic moments. It is concluded that rupture does not produce proper magnetic effect independent of the effect of separation, pure and simple, of the parts; at least so long as it is not accompanied by flexions involving a finite portion of the ruptured needle. This conclusion was subsequently confirmed. The author considers—first, rupture of saturated cylindrical needles perpendicular to the axis; then rupture of cylindrical unsaturated needles, regular, or presenting consecutive points; and, lastly, rupture of saturated needles parallel to the axis. He remarks that this rupture of a needle is, perhaps, one of the most delicate methods for ascertaining its regularity. On the third point it is stated that the sum of the magnetic moments of the separated steel laminæ of a magnetic bundle is considerably higher than the moment of the bundle. This is explained by consideration of the

two kinds of magnetism, temporary and permanent, of which steel is susceptible.

Pluvial Régime of the Torrid Zone in the Basins of the Indian and Pacific Oceans.—M. Raulin.—*En résumé*, in the torrid zone the differences of mean monthly temperatures, which are far from being so great as in the temperate zones, seem yet to have a considerable influence on the rainfall. To the north of a line, which sometimes coincides with the equator and sometimes rises more or less to the north, rain (often very abundant) falls especially in April and September, that is during the half-yearly hot period of the northern hemisphere. South of this region it especially falls during the other half-year period, October to March, which is the hot period of the southern hemisphere.

Note apropos of New Experiments by Professor Tyndall on the Acoustic Transparency of the Air.—M. de Fonvielle.—If moist air does not readily extinguish either acute or grave sounds, one does not see how it will facilitate the propagation of the former to exclusion of others. The sounds of a steam-whistle are not the only ones which strike the ear of aéronauts above the sea of clouds. They hear others, always very acute, but sometimes of considerably less intensity. The author supposes that the envelope of the balloon, tensely stretched by the gas, acts as a membrane, enabling one to hear certain sounds which, though very weak, have been able to pass through the clouds. He asks whether the sails of the yacht in which Prof. Tyndall sailed may not have produced an effect of this nature. He considers that aéronautic observations are the best calculated to throw light on this substance, so important to marine navigation.

Production of Yeast in a Saccharine Mineral Medium.—M. L. Pasteur.—The author has formerly shown that no ammonia is formed during alcoholic fermentation as was formerly assumed. He considers it established that alcoholic yeast can multiply in an aqueous solution of pure sugar, with an ammoniacal salt and the ash of yeast, or alkaline and earthy phosphates, including those of magnesia and of potash. This he regards as the first proof that the albumenoid matters of certain living beings may be formed by sugar and ammonia with mineral phosphates and sulphates without the aid of light and of "green matter." Yeast which has germinated in a mineral medium becomes more suited to multiply in a similar medium. It has become acclimatised.

Reply to M. Pasteur Concerning the Transformation of the Yeast of Beer into Penicillium Glaucum.—M. A. Trecul.—Another stage of the interminable Pasteur controversy.

Presence of Nitre in two Varieties of Amaranthus.—M. A. Boutin.—*Amaranthus ruber*, dried at 100° C., contains 16 per cent of nitrate of potash, which amounts to 22 grms. of nitrogen and 72 grms. of potash per kilo. of the dried plant. *Amaranthus atropurpureus* is still richer, containing 22.77 per cent nitrate of potash. It is probable that in their native country, India, these plants will be still richer in nitre.

On Certain Points Relating to the Efflorescence of the Two Hydrates Formed by the Sulphate of Soda.—M. D. Gernez.—The author maintains that the facts from which Coppet infers the existence of two isomeric modifications of the anhydrous sulphate of soda are not novel. He pointed out, in 1865, that effloresced sodic sulphate always causes a supersaturated solution of the salt to crystallise, whilst the sulphate dehydrated by heat does not induce crystallisation. Coppet infers from his experiments that there are two isomeric modifications of anhydrous sulphate of soda, one recognised by all chemists and produced above 33°, and one which, according to him, is obtained by drying ordinary sulphate of soda below that temperature. Gernez denies that the experiments of Coppet lead to this conclusion, and considers the fact of the co-existence of two hydrates in one and the same

liquid at the same temperature of great importance towards deciding the state in which bodies exist in their solutions.

Reaction of Chloride of Silver with Biniodide of Phosphorus.—A. Gautier.—50 grms. of pure biniodide of phosphorus were pulverised in a current of dry air, placed in a flask, and mixed with 60 grms. of dry chloride of silver. The reaction begins in the cold, and if the mixture is gently heated a colourless liquid distils over, which boils at 76° to 78°. This liquid is trichloride of phosphorus. If the heat is raised to 280° C. free phosphorus sublimes, whilst in the flask remain iodide of silver mixed with an excess of chloride, and of amorphous phosphorus. It is remarkable that in this reaction 2 equivalents of iodine are replaced by 3 of chlorine. The chloride of silver liberates at a low temperature a part of the phosphorus of the biniodide—a singular reaction.

Isomerism of Tercbenthen and Tereben from a Physical Point of View.—M. J. Ribau.—A paper unsuitable for abstraction.

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Bulletin de la Societe Chimique de Paris, tome xxi., No. 3, February 5, 1874.

At a meeting of the Society, January 2, M. Berthelot discoursed on the titration of permanganate of potash solutions, and maintained that oxalic acid was the only trustworthy reagent.

M. D. Tommasi, by acting upon camphor with chloride of benzyl in presence of a small quantity of zinc-powder, has obtained a series of seven hydrocarbons, whose boiling-points range from 108° to 203°.

MM. Meldola and Tommasi have prepared phenyl-trichloracetamide, $C_8H_6Cl_3ON$, by the action of aniline on the chloride of trichloracetyl. It is a compound insoluble in water, soluble in alcohol, and fusible at 94.5°. Fuming nitric acid converts it into a nitro derivative, crystallising in fine yellow needles.

M. Friedel discusses the formula assigned by Boutlerow to pinacoline.

Researches on the Oxides of Nitrogen, their Stability, and their Reciprocal Transformations.—M. Berthelot.—We have already noticed this paper.

Synthesis of Oxyl-urea (Parabanic Acid).—M. E. Grimaux.—This paper has been also already noticed.

Solubility of Succinic Acid in Water.—M. E. Bourgoin.—It is generally stated in chemical text-books that succinic acid dissolves in five times its weight of cold water. The author finds that at 0° water takes up 2.88 per cent of succinic acid; at 27°, 8.11; at 48°, 20.28; at 78°, 60.75; and at 100°, 120.86.

Metallurgic Treatment of the Bismuth Ore of Meymac.—M. A. Carnot.—One only of the bismuthic minerals of Meymac, the hydrocarbonate, is found in quantity sufficient for practical purposes. It has doubtless been formed by the action of water upon the sulphide, which will, therefore, be found at greater depths. The pounded ore is attacked by hydrochloric acid. The undissolved residue is twice subjected to the same treatment until exhausted, when it contains no appreciable proportion of bismuth. The solution is filtered, and iron is introduced, on which the whole of the bismuth is deposited as a heavy black powder. The solution is drawn off before the iron it contains has time to become oxidised and produce a deposit. The precipitate is washed in pure water, pressed in linen bags, and dried rapidly in a stove. It is then filled into black-lead crucibles, which are covered with coarse charcoal-powder, and heated gradually in a calcination furnace for forty-five minutes without exceeding redness. The bismuth is then run into ingot moulds, and is ready for sale.

Compounds of Thorium.—M. Cleve.—An important paper. The author has examined and described the oxide, normal hydrate, chloride, potassio-chloride, chloro-platinate, silico-fluoride, platino-cyanide, ferro-cyanide

sulpho-cyanide; nitrate, per-chlorate, chlorate, bromate, and iodate; carbonate of thorium and sodium; two sulphates; sulphate of sodium and thorium; sulphate of ammonium and thorium; sulphite; hyposulphate; seleniate; selenite; two orthophosphates; pyrophosphate; pyrophosphate of thorium and sodium; formiate, acetate, oxalate; oxalate of thorium and potassium; tartrate; tartrate of thorium and potassium. Thorium is not isomorphous with any element.

On Koussine.—M. C. Bedall.—Koussine, the active principle of koussou, is found, not merely in the flowers, but also in the stalks and leaves. It is sparingly soluble in water, but readily in alcohol, the ethers, and the alkalies; its composition is $C_{26}H_{22}O_5$.

Determination of Sulphur in Cast-Iron, Wrought-Iron, and Steel.—M. Koppmayer.—10 grainmes of iron, finely-powdered and sifted, are introduced into a bottle holding from $\frac{1}{2}$ to $\frac{3}{4}$ litre. The stopper has three holes. Through one of these passes a funnel with a ground-glass tap, its neck reaching to the bottom of the bottle. Through the second passes the tube at right angles, fitted with a tap, and reaching also to the bottom of the bottle. Through the third hole passes a delivery-tube, connecting the bottle to the condensing apparatus. This latter consists of a series of bulbs arranged like a staircase, so as to permit the gas to come into the greatest possible contact with the standard solution of iodine in iodide of potassium with which the condenser is filled. This solution ought not to be exposed to light. When the apparatus is arranged as above, the atmospheric air is first driven out of the bottle by means of a current of hydrogen gas introduced by the tube bent at right angles. When it is considered that the air is entirely expelled the tap of this tube is closed. The funnel is now filled with hydrochloric acid, its tap is opened, and by means of the application of heat the acid is allowed to run down upon the iron without allowing any common air to enter. Hydrogen and sulphuretted hydrogen are formed, which pass into the condenser. Acid is thus added until all disengagement of gas ceases. The bottle is then heated until its contents boil, a little water having been first added by means of the funnel. After these operations hydrogen is allowed to enter anew to sweep out all remaining gases. The iodised solution is then poured out, care being taken to rinse the bulb-tube thoroughly, and titrated with hyposulphite of soda, so as to find the remaining proportion of free iodine. The difference between the original amount of iodine present in the solution and the amount thus found, shows the proportion of iodine which has been converted into hydriodic acid, and which is proportional to the sulphur contained in the sample under examination.

On Moistened Coal.—Ferd. Fisher.—The author shows by a calculation of the heat disengaged that by moistening coal we lose both in the quantity of heat and in the temperature attained.

Carbonisation of Wood in Closed Vessels.—M. von Reichenbach.—The charcoal obtained in retorts can be more abundant or of better quality than that prepared in stacks. The dimensions of the retorts affect the quality of the charcoal. In small retorts, where the carbonisation is rapid, a light and porous charcoal is obtained. In furnaces the carbonisation is slow, and the charcoal produced yields neither in weight nor in density to the best obtained by the ordinary process. When wood is distilled slowly, whether in retorts or in furnaces of masonry, the hygroscopic water is first expelled; then follows the pyroligneous acid, which falls in strength after having attained a maximum. Then come the tarry matters accompanied by combustible gases, after which the carbonisation is complete. If the distillation is stopped when the pyroligneous acid ceases coming over, the charcoal obtained is the so-called red charcoal. This imperfectly carbonised wood retains in a solid form, beside carbon, the bodies which by their decomposition yield the tars and gases, and it has parted with all its water and

with the available acetic acid. This red charcoal yields as much heat in the metallurgical arts as black charcoal, and, moreover, it disengages gases which are useful in such cases, and which when charcoal is burned in stacks or clamps are wasted in the air. Wood may be considered as containing 40 per cent of carbon, 40 of combined water, and 20 of hygroscopic moisture. In complete charring, 100 kilos. of hard wood yield 20 kilos. of charcoal, 5 kilos. of tar, and 5 kilos. of acetic acid, besides the gas. In case of incomplete charring the products are acid, and red charcoal, which contains all the matters representing charcoal, tar, and gas. The weight of red charcoal exceeds by more than one-half that of the black charcoal from the same quantity of wood. Red charcoal is less brittle than black, and bears carriage better.

Action of Stannite of Sodium on Gun-Cotton.—M. R. Böttger.—When well made gun-cotton is boiled for ten minutes with a concentrated solution of stannite of sodium there is formed a clear yellowish solution, which may be diluted with water without becoming turbid. The addition of hydrochloric acid precipitates regenerated cellulose. As cellulose itself is insoluble in the stannite of sodium, the above reaction may serve for the detection of unconverted cotton in samples of gun-cotton.

MISCELLANEOUS.

The Adulteration of Food Act, 1872.—Mr. Wentworth G. Scott has lately been appointed Analyst to the Borough of Hanley under the above Act. Mr. Scott already holds the same office in relation to the counties of Derby and North Staffordshire.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of sulphate of soda. Thomas Nixon and Paul Quin, both of Hebburn, near Newcastle-on-Tyne. April 26, 1873.—No. 1522. In order to save the cost of the fire of the salt-cake furnace, we propose to utilise the waste heat of the ball-turnace, or other available furnace or pan, in such a manner that it will serve to complete the conversion of the salt-cake into sulphate of soda.

Improvements in the manufacture of white-lead and apparatus therefor. William Thompson, 101, Wandsworth Road, Surrey. April 28, 1873.—No. 1532. This invention relates to improvements in the process of and apparatus used in manufacturing white-lead. The melting-pan is made in compartments for regulating the temperature and securing the purity of the blue-lead. This lead is made into thin sheets of open texture by pouring it into a revolving cylinder kept cool, and it is granulated by running it in a thin stream between a roller and an inclined knife, and receiving it in water. The sheets and granules are charged on trucks, which are run upon rails into the chambers where the chemical reagents act on the lead so as to convert it into white-lead, the trucks charged with the converted lead being run out at opposite doors. The converting chambers are supplied with acid gases and vapours heated before their introduction in steam-jacketed pipes or vessels.

Improvements in the treatment of sewage, and in the manufacture of manure therefrom. Walter Brown, 30, Pulross Road, Stockwell, Surrey. April 29, 1873.—No. 1555. The features of novelty of this invention consist in treating sewage with the residue of blackstone, or other similar shaly mineral, after being calcined so as to fix the gases, and thus form a manure.

Improved apparatus for the manufacture of nitrate of soda. Cuthbert Russell, engineer, 2, Talbot Court, Gracechurch Street, London. (A communication from Robert Moore and Tomas Robert Williamson, both of Iquique, Peru, South America). April 29, 1873.—No. 1556. The features of novelty of this invention consist of closed cachucho or boiling-tank, fitted with perforated revolving cars, the arrangement and operations of which can only be understood by reference to the drawing accompanying the specification.

Improvements in the preparation and employment of indigo-blue dye. Alexander Melville Clark, patent agent, 53, Chancery Lane, Middlesex. (A communication from Jerome Marble, Worcester, Massachusetts, U.S.A.). April 29, 1873.—No. 1557. The invention consists in dissolving indigo in a solution of lime, soda-ash, and muriate of tin crystals. To colour with this solution, clear water is heated to 120° Fahrenheit, and the solution added in quantities to produce the shade desired, bran being added to regulate the alkalies.

Improvements in the manufacture of explosive compounds. Alfred Vincent Newton, mechanical draughtsman, 66, Chancery Lane, Middlesex. (A communication from Alfred Nobel, Paris). April 30, 1873.—No. 1570. This invention consists in the use of paraffin, ozokerit,

stearine, naphthalin, or any other fatty or sticky matter insoluble in water, as ingredients in explosive compounds containing nitrates, hygroscopic or not, and nitro-glycerin.

A new or improved process and furnace for the manufacture of metallic alloys. Alexander Browne, of the firm of Browne and Co., patent agents, 85, Gracechurch Street, London. (A communication from the Foundries and Forges Co., Terre Noire La Voulte and Besseges, France). May 1, 1873.—No. 1574. The features of novelty of this invention as regards the process consist in mixing iron-filings, turnings, or granulated wrought-iron, cast-iron, or steel, or pulverised spongy iron, or any other scraps of cast-iron or steel in a nearly uniform state of division, and mixing them with ores containing manganese, tungsten, titanium, or any of these combined, or with quartz. The ores or quartz are finely pulverised, and mixed in sufficient quantities to form the required alloy. As regards the furnace, the novelty consists in constructing it as follows:—The furnace is composed of a cupola made of very hard fire-bricks containing a great quantity of alumina; the boshes are constructed of lime, magnesia, or pure alumina; the crucible or hearth is made of carbon, lime, or magnesia. The carbon crucible is made in one piece by moulding a mixture of pure graphite or gas-coal or pure coke with tar in a box made of strong sheet-iron, and heating the whole well closed up to a dark red heat for a few hours, a compact and very hard mass is thus obtained.

Improvements in the manufacture of Portland cement. John Ward, Battersea, Surrey. May 3, 1873.—No. 1599. This invention consists in the addition of a certain quantity of quick-lime to the liquid chalk and clay when passed from the wash-mill into a mixing-mill. The lime in the process of slaking absorbs a large quantity of the water from the liquid chalk and clay, leaving it sufficiently solid to go at once to the drying-stoves, and from thence to be burnt and ground in the ordinary manner. Running the liquid into backs or reservoirs is thus avoided, and a considerable saving of time and labour thereby effected, while the quality of the cement is improved.

Certain improvements in the manufacture of floor-cloths, roofing, and waterproof fabrics generally, some of the waterproofing material used in such improvements being also applicable as a varnish and cement, and for making solid materials, and coating ships' bottoms, and other rough purposes. Alexander Rollason, chemist, Totterdown, Bristol. May 5, 1873.—No. 1610. The first part of my invention consists in the use of limmer and such like rock asphalts, and reducing them to a state of liquefaction not by the use of bitumen, which has heretofore been used for that purpose, but by what is commercially known as crude paraffine or petroleum oil or other unpurified oils analogous thereto. The second part of my invention consists in dissolving animal products in water, such as glue, gelatin, albumin, and such like vegetable gums as will dissolve in water, as acacia, senegal, dextrin, and also starch, flour, and such like substances. The third part of my invention consists in mixing the before-named cotton waste with glue as described, or with animal products, linseed, or other drying oils or varnishes. Fourthly, I use the mixture of animal products and vegetable gums when mixed with bichromate of potash as described for the manufacture of solid substances, as buttons, knife handles, &c., which may be moulded or pressed into shape.

NOTES AND QUERIES.

Artificial Fruit Essences.—Can any of your readers inform me if any book exists giving particulars of manufacture of artificial fruit essences and of their composition, or kindly give me some information on the subject.—P. H. M.

Purifying Hydrochloric Acid.—Could you kindly inform me, through the medium of your valuable journal, by what process I shall be able to expel or precipitate arsenic acid from muriatic acid, commonly known as tower salts, produced at alkali works, without injuriously affecting the article.—J. S. O.

MEETINGS FOR THE WEEK.

MONDAY, March 23.—Medical, 8.
London Institution, 4.
TUESDAY, 24.—Royal Institution, 3. Prof. Tyndall, "On the Physical Properties of Liquids and Gases."
Civil Engineers, 8.
Anthropological, 8.
WEDNESDAY, 25.—Society of Arts, 8. Lieut. H. H. Cole, R.E., "On the London International Exhibition of 1874."
Geological, 8.
THURSDAY, 26.—Royal Institution, 3. Prof. W. C. Williamson, "On Cryptogamic Vegetation (Ferns and Mosses)."
Royal, 8.30.
FRIDAY, 27.—Royal Institution, 8; Weekly Evening Meeting. Prof. A. C. Ramsay, on "The Physical History of the Rhine," 9.
Quckett Microscopical Club, 8.
SATURDAY, 28.—Royal Institution, 3. Mr. C. F. Newton, Keeper of Greek and Roman Antiquities, British Museum, "On Mr. Wood's Discoveries at Ephesus."

Sanitary Chemistry.—Dr. Medlock (late of Great Marlborough Street and Tavistock Square) undertakes the analysis of water, food, &c., and the scientific investigation of all matters relating to the public health.

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Hours of Lecture for Session 1872-73:—

Chemistry (Inorganic)	10 a.m.	Materia Medica	4 p.m.
(Organic)	2 p.m.	Pharmacy	2 p.m.
Botany (Structural)	11 a.m.	Classics (Junior)	9 a.m.
(Systematic)	3 p.m.	(Senior)	4 p.m.

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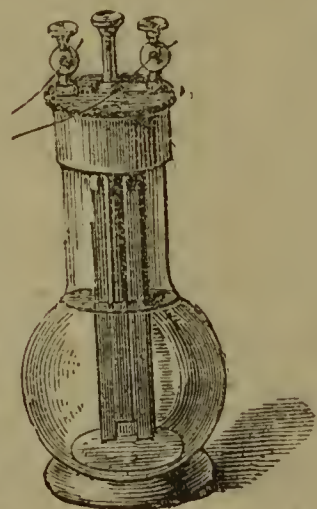
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THE CHEMICAL NEWS.

VOL. XXIX. No. 748.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 127).

THE formula employed for the calculation of the true weight of a substance *in vacuo*, from data given by two weighings, one at ordinary and one at a greatly diminished air-pressure, is as follows:—

Let H denote the substance to be weighed, and h its true weight (*in vacuo*) in grains.

First Weighing in Air of Ordinary Density.

Let W denote the material weight which balances H ,

w " " true weight of W observed in air,
 x " " weight of air displaced by W ,
 t " " temperature,
 p " " pressure, in height of mercury, reduced to 32° F.,

b " " bulk of W in grs. of water at max. density,
 k " " weight of air displaced by H ;

w, x, t, p, b being given, required to find k ,
 $h - k = w - x$.

Second Weighing in a Rare Atmosphere.

Let γ denote the weights which balance H ,

y " " true weight of γ in air of ordinary density,
 z " " weight of air displaced by γ ,
 t' " " temperature,
 p' " " pressure, in height of mercury, reduced to 32° F.,

$b' = \frac{y}{w} b$ " bulk of γ in grs. of water at max. density,

l denote the weight of air displaced by H ;

y, t', p', b' being given, to find l and z ,

$$h - l = y - z;$$

hence $k - l = y - w + x - z$.

By tables A and B,

$$\log. \frac{\text{density rare air}}{\text{max. den. water}} =$$

$$= \log. (p' - 0.378 \frac{v}{t}) + \log. \frac{0.001293893}{1 + 0.003656 \frac{1}{760}};$$

$$\therefore \log. b' + \log. \frac{\text{density rare air}}{\text{max. den. water}} = \log. z,$$

$$\frac{l}{k} = \frac{\text{density rare air}}{\text{density common air}} = n \text{ (suppose).}$$

$$\text{Let } m = y - w + x - z; \text{ then } k - l = m, \frac{l}{k} = n.$$

$$\text{Hence } l = nk, k - nk = m, k = \frac{m}{1 - n}, l = \frac{mn}{1 - n}.$$

$$\text{Hence } h = w - x + \frac{m}{1 - n}; \text{ or } h = y - z + \frac{mn}{1 - n}.$$

To illustrate the application of this formula, I will reduce the weighings of one of the determinations (E).

Substance weighed.	Balance used.	Weights, actual.	True value in air.
(H)		(W)	(w)
Glass apparatus.	Vac.	765.8081	765.814578
(H)		(\gamma)	(\gamma)
Glass apparatus.	Vac.	766.1133	766.122626

Weight of air displaced.	Temperature.	Bar. (reduced to 32° F.).
(x)	(t)	(p)
0.044547	65° F. = 18.5° C.	29.848
(vol. in water max. density = 36.326)		(758.125 millims.)

	(t')	(p')
0.044546	63° F. = 17° C.	11.73 in.
		(29.79 millims.)

CALCULATION OF VACUUM-WEIGHT OF FLASK FROM ABOVE WEIGHINGS.

Let h = true weight in vacuum of flask,

$$w = 765.814578,$$

$$x = 0.044547,$$

$$t = 65° \text{ F.} = 18.33° \text{ C.},$$

$$p = 29.848 \text{ in.} = 758.12 \text{ millims.},$$

$$b = 36.326,$$

$$y = 766.122626,$$

$$t' = 63° \text{ F.} = 17.2° \text{ C.},$$

$$p' = 11.73 \text{ in.} = 29.79 \text{ millims.}$$

$$\log. \frac{\text{den. atmos. air}}{\text{max. den. water}} = \log. 758.12 - 4.00 + 4.204149 - 10;$$

$$\therefore \quad \quad \quad = 2.8774430 + 4.204149 - 10;$$

$$\therefore \quad \quad \quad = 7.0815920 - 10.$$

$$\log. b' = \log. 766.122626 - \log. 765.814578 + \log. 36.326;$$

$$\therefore \quad b' = 2.8842970 - 2.8841230 + 1.5602176;$$

$$\therefore \quad b' = 1.5603916.$$

$$\log. \frac{\text{density rare air}}{\text{max. den. water}} = \log. (29.79 - 3.63) + 4.204898 - 10$$

$$\therefore \quad \quad \quad = 1.4176377 + 4.204898 - 10;$$

$$\therefore \quad \quad \quad = 5.6225357 - 10.$$

$$\log. z = 1.5603916 + 5.6225357 - 10;$$

$$\therefore \quad z = 7.1829373 - 10;$$

$$\therefore \quad z = 0.001524.$$

$$\log. \frac{l}{k} = 5.6225357 - 7.0815920;$$

$$\therefore \quad \frac{l}{k} = 8.5409437 - 10;$$

$$\therefore \quad n = \frac{l}{k} = 0.034749;$$

$$\therefore \quad 1 - n = 0.965251.$$

$$m = 766.122626 - 765.814578 + 0.044547 - 0.001524;$$

$$\therefore \quad m = 0.351071.$$

$$k = \frac{m}{1 - n} = \frac{0.351071}{0.965251};$$

$$\therefore \quad k = 0.3638.$$

$$h = 765.814578 - 0.044547 + 0.3638;$$

$$\therefore \quad h = 766.133831.$$

WEIGHING OF GLASS APPARATUS + NITRATE OF THALLIUM.

Vacuum-Balance.

In air. Left pan removed. Platinum weights.

After third heating (to fusion) and cooling—

Weights.	True value in air.	Weight of air displaced.	Vol. in water at max. den.
600	599.998340	0.035533	28.970
100	99.991420	5887	4.800
60	59.993232	3483	2.840
30	29.999991	1668	1.360
6	5.998268	355	.290
3	3.000469	171	.140
.06	0.061472	3	.003
.0031	0.003099	0	.000
799.0631	799.046291	0.047100	38.403
Pan = 206.3733	206.379646	0.012040	9.824
1005.4364	1005.425937	0.059140	48.227

Therm. = 73° F. = 22.7° C.

Barom. = 29.891 in. at 0° C. = 759.22 millims.

$$1005.425937$$

$$765.814578 = \text{weight of glass apparatus (see } w, \text{ preceding).}$$

$$239.611359 = \text{weight of thallium nitrate in air.}$$

* A Paper read before the Royal Society June 20, 1872.

The weight of air displaced, &c., is taken separately for each weight in all cases, but is omitted in subsequent examples (the sum being given), to prevent the introduction of useless figures.

WEIGHING OF GLASS APPARATUS + NITRATE OF THALLIUM
IN RARE ATMOSPHERE.

Vacuum-Balance.

Exhausted.	Left pan removed.	Platinum weights.	
Weights.	True value in air.	Weight of air displaced.	Vol. in water at max. den.
799.3600	799.346792	0.047117	38.423
Pan = 206.3733	206.379646	0.012040	9.824
1005.7333	1005.726438	0.059157	48.247
Therm. = 69.5° F. = 21° C.			
Barom. = 29.775 in. = 756.27 millims. at 0° C.			
Gauge = 25.141 in. = 638.57 millims. at 0° C.			
	756.27		
	638.57		
117.70 millims. pressure.			

Weight of left scale-pan of air-balance, which was removed to relieve the beam in weighing the heavier pieces of apparatus—

Weight.	True value in air.	Weight of air displaced.	Vol. in water at max. den.
179.7365	179.719377	0.010429	8.513

Weight of left scale-pan of vacuum-balance taken in air-balance—

Weight.	True value in air.	Weight of air displaced.	Vol. in water at max. den.
206.3733	206.3719646	0.012040	9.824

Weight of air displaced by scale-pan = 0.02403 gr.

Volume in water of maximum density = 24.244 grs.

(To be continued.)

ON THE
METHODS IN USE FOR DETERMINING
THE VALUE OF VEGETABLE AND ANIMAL
OILS.*

By J. J. COLEMAN, F.C.S.,
Associate of the Institute of Engineers, Scotland.

It is not easy to get at an accurate statement of the number of the fixed oils having a vegetable or animal origin, and which, having been examined or brought into use, have been found to differ from each other more or less in physical constitution or practical utility. Watts enumerates, in his "Dictionary of Chemistry," 49 vegetable oils, 11 fish oils, and 5 animal oils, making a total of 65. This list is defective, as it does not include some Indian products shown in the Exhibition of 1851, nor do we find the olein obtained from tallow alluded to.

Each of these fixed oils has some distinguishing characteristic. Possessing a general family likeness, no two are exactly alike.

Upon the possession or non-possession of certain valuable qualities esteemed by consumers of oil depend the practical applications of the oil, checked, however, from time to time by the relative scarcity or abundance of the oil; these two considerations establishing the market value. Accordingly we find, upon examining broker's circulars or Board of Trade returns for the last five or ten years, one particular class of oil, sperm oil, having an average yearly value of, in round numbers, £95 per ton; a second class, £60 per ton, represented by the animal oleins; a third class, £50 per ton, represented by the various qualities of olive oil; a fourth class, £40, represented by rape oils; a fifth class, £35 per ton, represented by the drying oils; and a sixth class, about the same price, represented by the stinking fish oils.

* Communicated to the Chemical Section of the Philosophical Society of Glasgow.

So great variations in price amongst the different classes enumerated show that they differ, for practical purposes, very much in utility, and we can scarcely suppose that the dealers in, and consumers of, oil, who have something considerably more than 100,000 tons, or 25,000,000 gallons, passing through their hands yearly, of the aggregate value of at least five or six million pounds sterling can preserve such class distinctions year after year without some solid basis which deserves the careful attention of the chemist. And these differences in the properties of the fixed oils is by no means always dependent upon the mucilaginous, albuminous, or odoriferous impurities they contain, but by actual differences in the properties, and perhaps constitution, of the olein, palmitin, or stearin, of which they are constituted, more especially, perhaps, in regard to their susceptibility of ready oxidation by atmospheric oxygen. The precise nature, however, of the variations in the proximate principles of oils is very little understood; indeed, if we had accurate knowledge on the matter, we might be able, perhaps, soon to boast of being able to make a commercial analysis of oil of some value.

As the matter now stands in reference to the detection of adulterations of animal or vegetable oils, all we can boast of are a few empirical tests, some of them of doubtful character, by which the absence of certain oils in mixtures can be sometimes inferred, and in a few cases the proportions in which they exist can be roughly guessed at.

When we consider the labour and perseverance required in order to get thoroughly acquainted with the individual characteristics of the chemical elements, it is obvious that to get similarly acquainted with the characteristics of the fatty oils, which are of greater number than those of the elements, is no light task. It is therefore proposed to point out in a subsequent part of this paper how, in the examination of commercial oils, we can much simplify our work by eliminating all such oils, as by reference to brokers' or merchants' circulars can be proved to be dearer than the supposed oil under examination. It may be taken as a commercial maxim that no man adulterates for the benefit of the public when it entails loss to his own pocket.

Before going further into this part of the subject we will review the chemical and physical tests which have been proposed for detecting adulteration in oils.

The most elaborate work in this direction was undertaken by the late Prof. Calvert, who studied the action of acids and alkalis in different states of dilution upon oils, and in special reference to the colour and appearance of the mass formed by combining 1 part of the reagent with 5 parts of oil at normal temperatures when the acids were used, and at boiling temperatures in case of the alkalis being used. The reagents used by Calvert were:—

1. Caustic soda of 1.340 sp. gr.
2. Sulphuric acid of 1.475 "
3. " " 1.530 "
4. " " 1.635 "
5. Nitric acid of 1.180 "
6. " " 1.220 "
7. " " 1.330 "
8. Product of No. 7 treated with twice its bulk of caustic soda and boiled.
9. Mixture of concentrated sulphuric and nitric acid.
10. Aqua regia.
11. The product of No. 10 treated with twice its bulk of caustic soda and boiled.
12. Syrupy phosphoric acid.

Calvert furnishes us with tables of results comprising 180 reactions, the observer to notice various shades of colour produced. The colours in a few cases, as in the reactions with fish-oils, are decided, but a large number of them appear to be of a very nondescript character, such as brownish, greenish, yellowish, dirty white, dirty green, slight yellow, &c. The observer has also to observe the

fluidity or non-fluidity of the mass resulting from the action of caustic soda upon the oil.

Now, on examining Calvert's tables, it will be observed that he only experimented with fifteen oils, those very important commercial oils, tallow olein and cotton-seed oil, being entirely omitted, besides fifty others of minor importance. It is sufficiently formidable having to study Calvert's 180 reactions, especially when we take into account the great prevalence of partial colour-blindness; but the task becomes very formidable if it becomes necessary to acquaint ourselves with the colours which would be produced in similar circumstances by the half-hundred or so of other oils not included, and which may probably give reactions which might be confused with those of the oils already examined.

Many of the colours produced may be owing to the presence of more or less mucilaginous matter, or small portions of the inspissated juices of the plant or animal, which really have no great bearing upon the genuineness of, or the adaptability of, the oil for the purposes for which it may be required.

Calvert himself does not state whether he used refined oils or not. Thus rape oil is used by the public both refined and unrefined, the latter being called brown rape or sweet oil; and the olives are generally used unrefined, though olive oil refined as white as water is known in the market.

The particular extent to which an oil is refined will probably give great varieties of shade. Thus, a refined rape oil from Germany gave with the 1.635 sulphuric acid test quite a different colour from a sample from Belgium; still there was evidence sufficient of other kinds to convince me both oils were genuine, and precisely the same remarks apply to two samples of cotton oil—one refined in the United States and the other refined in England.

Calvert, indeed, states himself that the colour-test is not applicable for detecting some oils. In dealing with a supposed mixture of lard oil and rape oil, he says, the colour reactions not being decisive, one conclusive test will distinguish them,—viz., that after treatment with aqua regia, and subsequent boiling with caustic soda, lard oil will give a fluid mass, and rape oil a fibrous mass. This experiment was repeated, not only with lard oil, but with tallow olein, and it was found that the caustic soda gave even a more fibrous mass with tallow olein than with rape oil—although his remarks about lard oil are correct; but this experience shows that his tables, to say the least, are very defective, and, in this particular case, worse than useless—being misleading,—seeing that tallow olein is as valuable as lard oil. However, some of Calvert's more marked reactions are sometimes useful and valuable as adjuncts in testing operations.

M. Heidenrich, M. Penot, and M. Marchand have also proposed colour-tests from the reaction of concentrated sulphuric acid upon oils, employing only a few drops of the oil placed upon a porcelain plate, but these methods are open to the same doubts and uncertainty as those of Calvert, particularly to the extent or nature of the colouration depending upon the accidental impurities of the oil.

A method of distinguishing fatty oils by the differences in the amount of heat produced by mixing 1 part of sulphuric acid with 3 parts of the oil to be tested was suggested by Maumené and elaborated by Fehling. The idea is pretty, easy of execution, and interesting in results. There is great variation in the amounts of heat produced. We find, for instance, a gain of temperature of 100° where rape oil is used, as compared with 68° when olive oil is used. This method has been investigated by the authors in so far as linseed, rape, olive, and poppy oils are concerned, and I have myself applied it as a secondary test in distinguishing several other oils.

The relative viscosities of the fatty oils is a very important and interesting subject. Schubler and Ure published some experiments on the subject many years ago. More recently I have extended their experiments, the apparatus employed being constructed as annexed:—

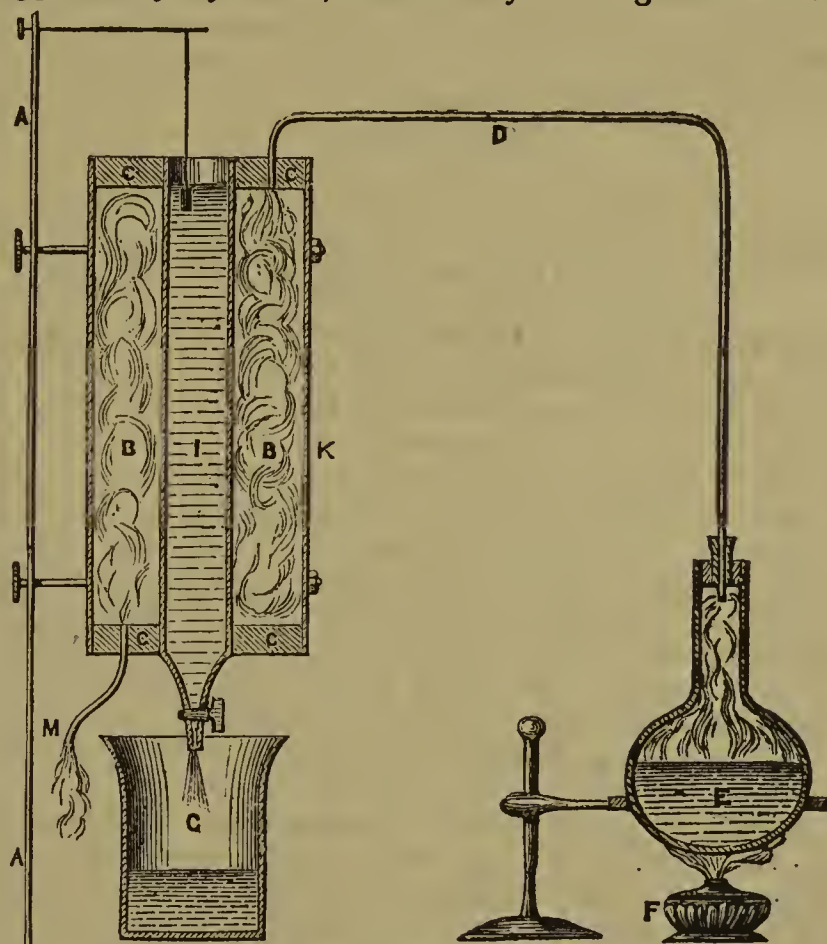
The results obtained at 120° F. were—

	M. Sec.
French refined colza rape.. ..	11 0
German refined rape	8 30
Neats'-foot oil	8 30
Olive	8 15
E. I. ground-nut	8 0
Tallow oil	7 30
Southern whale	7 40
Lard oil.. ..	7 0
Cotton-seed oil	7 0
Seal oil	6 30
Lisbon seed oil	6 35
Sperm oil	5 0

A second series of experiments with a smaller apparatus confirmed the difference observed between rape oil imported from Germany and that imported from France, Belgium, and Holland—

	M. Sec.
Belgian colza	8 15
German rape	7 30
Olive	7 30

The relative liability of fatty oils to ignite spontaneously when in contact with cotton or other waste, has been suggested by my friend, Mr. Gellatly as being characteristic.



SKETCH TO ILLUSTRATE TERM VISCOSITY AS USED BY MR. COLEMAN.

I is the cylinder containing the oil. B the chamber filled with steam, and surrounded by the outer cylinder, K (both of glass); the steam chamber is closed top and bottom by india-rubber plugs, c, c, c, c. The steam being generated in the flask, F, passes by the india-rubber pipe into the chamber, B, until the oil reaches 120°; the stopcock is then opened, and the time taken for the oil to run out registered. The apparatus is made of such size as to allow German refined rape oil to run through in 8m. 30 secs.

The experiment is made by imbing a handful of cotton waste with the oil to be tested, and placing it tolerably loosely in a paper-box enclosed in a hot-air bath kept at a temperature of from 130° to 200° F. After a certain length of time, characteristic of each oil, the mass enters into active combustion. Mr. Gellatly's figures are as follows:—

	H. M.
Boiled linseed	1 15
Seal oil	1 40
Raw linseed	4 0
Lard oil.. ..	4 0
Gallipoli olive	5 0
Refined rape.. .. (about)	9 0

Equal parts of mineral oil and seal oil refused to ignite:

Mr. Gellatly's experiments were repeated with the special view of studying the action of mineral oil in preventing or retarding combustion, and the results I attained (which were also directed to the effect of substituting wool or jute waste for the cotton) were as follows:—

	H. M.
Seal oil on wool	3 0
Whale oil on wool	3 15
Whale oil on cotton	3 0
Whale oil on jute	9 0
Olive oil on cotton	4 0
Oleic acid on wool	13 30
80% olive oil and 20% mineral oil ..	8 0

The following mixtures refused to ignite after 26 hours' exposure to 190° to 200° F.:—

Equal parts of olive oil and mineral oil on cotton.
Equal parts of whale oil and mineral oil on jute.
Equal parts of seal oil and mineral oil on wool.
Equal parts of oleic acid and mineral oil on wool.
80% of oleic acid and 20% of mineral oil on wool.

Thus it was rendered evident that the addition of mineral oil to animal and vegetable oils has so powerful an effect in retarding the oxidation of the oil which causes the combustion that the presence of even 20 per cent materially delays, whilst the 50 per cent entirely prevents, ignition under the circumstances of the experiment. Mr. Gellatly's experiments were made between 130° and 170° F., and mine between 180° and 200° F.

(To be continued).

CHEMISTRY APPLIED TO THE DETECTION OF ADULTERATION.

By ALFRED H. ALLEN, F.C.S.,
Public Analyst for the Borough of Sheffield; Lecturer on Chemistry at the Sheffield School of Medicine.

(Continued from p. 130.)

I. Coffee and Chicory (continued).*

THE ash of coffee showing a remarkable constancy of composition, it occurred to me that the percentage of ash soluble in water would be a valuable criterion of the purity of any sample of coffee, and afford a simple and ready means of approximately estimating the percentage of chicory present. Of course more experiments are required before the method can be depended on, but it appears the most promising of any, as its accuracy would be unaffected by variations in the process of roasting.

I ignited three samples of genuine coffee of different kinds, and three of chicory, taking 5 grms. for each experiment. After weighing, the ash was boiled in water, the liquid filtered, the clear solution evaporated to dryness, and the residue heated to dull redness and weighed. The following were the proportions in 100 of the sample:—

	Total Ash.	Soluble Ash.	
1. Coffee	3.86	2.95 = 76 per cent of total ash.	
2. "	3.95	3.40 = 86 " "	
3. "	4.20	3.38 = 80 " "	
Average of coffees	4.00	3.24 = 81 " "	
1. Chicory (foreign)	5.36	1.20 = 22 " "	
2. " " "	5.05	1.83 = 36 " "	
3. " (English)	4.90	2.18 = 44 " "	
Average of chicories	5.06	1.74 = 34 " "	

The proportion the soluble ash of the chicories bears to the total varies considerably, owing to the different quantities of silica present in the samples, and the percentage of soluble ash is not so constant as in the case of coffee.

Assuming 3.24 per cent as the average soluble ash of coffee, and 1.74 as that of chicory, the percentage of

* Through a misunderstanding, this matter was not incorporated in the article on p. 129.—A. H. A.

coffee in a mixture would be represented by the following equation, where C is the percentage of coffee, and S the percentage of soluble ash:—

$$C = \frac{(100S - 174)2}{3}$$

The following are the determinations of Messrs. Graham, Stenhouse, and Campbell, of the colouring powers of coffee and its different adulterants, when roasted and infused in equal quantities of water. No attempt appears to have been made to exhaust the samples.

Caramel	1000
Mangold-wurzel	602
Bouka (a coffee substitute)	602
Black malt	549
White turnips	500
Carrots	500
Chicory (darkest Yorkshire)	450
Parsnips	400
Maize	350
Rye	350
Dandelion root	300
Red beet	300
Bread raspings	275
Acorns	200
Over-roasted coffee	183
Highly-roasted coffee	173
Medium-roasted coffee	144
Another specimen coffee	150
White lupin seed	100
Peas	73
Beans	75
Spent tan	30
Brown Malt	25

Though the method of Messrs. Graham, Stenhouse, and Campbell is objectionable, for reasons previously stated, I have found the colour of the infusion gives a very fair approximate estimate of the proportion of chicory present when the following modified process is adopted:—Instead of caramel I employ, as a standard of comparison, a mixture of various kinds of coffee with an equal weight of mixed chicory.

Mixed chicory gives almost exactly three times as strong a colour as the average coffee, and separate samples of chicory do not vary more than from 2.8 to 3.2 in colouring power, when compared with the same sample of coffee.

One gramme of the standard mixture of equal parts of coffee and chicory, and the same weight of the sample to be tested, are boiled for a few minutes with 20 c.c. of water. The liquids are cooled, and passed through a double filter, the insoluble portion being repeatedly boiled with fresh quantities of water until exhausted. The solution of the standard mixture is then made up with water to 200 c.c., and the solution of the sample to 100 c.c. 10 c.c. of the latter liquid are poured into a narrow Binks's burette, and some of the standard solution into a test-tube of exactly equal bore. If the sample consists of pure coffee the two liquids will now be of exactly similar tint, but if chicory be present the liquid in the burette will be the darker, in which case water is added till the tints are precisely equal. (The tints are best observed by placing a piece of wet filter-paper behind the tubes while they are held up to the light.) When this point is attained, the volume of the liquid in the burette is observed. Each c.c. of water added corresponds to 5 per cent of chicory in the sample. Thus, if the liquid in the burette measures 17 c.c., the sample contains 35 per cent of chicory.

From the density of a solution of a sample of mixed chicory and coffee, prepared as described on page 130, the proportions can be readily calculated by the following formula, in which C represents the percentage of coffee in the mixture, and D is the density of the solution:—

$$C = \frac{(1020.6 - D)100}{12}$$

My own estimations of the density of pure coffee infusions have given a mean of 1008.7, closely agreeing with the determinations of Messrs. Graham, Stenhouse, and Campbell, but I found the infusions of chicory often had as high a density as 1025.

It will be seen that the proportions of coffee and chicory, in mixtures of the two, can be approximately ascertained by the amount of soluble ash, by the colour of the infusion, and by the density of a solution of 1 part in 10 of water. With substances of definite composition one method would be sufficient, but with articles of so variable a nature as coffee and chicory an analyst would be very unwise to rely on the indications afforded by any method taken singly. When the different determinations are approximately concordant, the proportion of chicory may be considered proved. Of course it is not necessary to examine every sample fully, but when the microscope and the cold-water test have proved the presence of chicory it is very desirable to ascertain the proportion in which it exists. When the coffee contains other adulterants as well, the problem becomes too complicated for solution in the present state of the subject.

Infusions of coffee and chicory are quickly and completely decolourised by potassium permanganate. I have taken advantage of this fact for ascertaining the presence of starch in coffee and chicory. The following method is preferable to that in which animal charcoal is employed:—The sample is boiled for a few minutes with water, and, when cool, the liquid is acidified with sulphuric acid, and permanganate added till the colour of the solution is destroyed. The clear liquid is then decanted or strained away from the insoluble matter, and tested for starch with solution of iodine. The well-known blue colouration is produced if the sample was adulterated with any cereal or leguminous seed, and the intensity of the tint affords a rough idea of the extent to which the adulteration was practised. As this test only occupies a few minutes, and a negative result by it proves the absence of a large class of adulterants, it will often save the trouble of a tedious examination under the microscope.

The insoluble matter remaining after treatment with permanganate, &c., can be advantageously examined under the microscope, the peculiar structure of chicory, &c., being more readily observed on account of the removal of the colouring matter.

The most common adulterants of chicory and coffee are caramel, locust beans, acorns, rye, maize, mangold-wurzel, and carrots, but the use of most of these admixtures has been almost abandoned since the New Adulteration Act came into operation.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 17, 1874.

Dr. ODLING, F.R.S., President, in the Chair.

THE names of the visitors having been announced, and the minutes of the previous meeting read and confirmed, Messrs. A. Bottle, J. Linford, and Henry Deacon were formally admitted Fellows of the Society.

The names read for the first time were those of Messrs. Frederick W. Fletcher, Alfred A. Wolff, and William Pearce, jun.

For the third time—Messrs. Edward Townley Hardman, Leslie Crassweller Hill, Thomas William Shore, William Kellner, and Andrew Fuller Hargreaves, who were ballotted for and duly elected.

The PRESIDENT then called on Professor JAMES DEWAR to deliver his lecture "*On Dissociation.*"

The LECTURER premised that he had no new facts to

bring before his audience, but must content himself with condensing and epitomising the labours of others. There were two very remarkable ideas which had sprung up early in the history of our science connected with this subject of dissociation. Of these, one was that of Priestley on the ameliorating action of vegetables on our atmosphere; the other that of Hutton, the geologist, who, in discussing the constitution of rock masses, came to the conclusion that they were formed under great pressure, and that this pressure modified the action of heat on the rock mass. He did not, however, experimentally prove it to be the case; this was reserved for his pupil, Sir James Hall, afterwards President of the Royal Society, who, in his classical investigation, proved that carbonate of lime could be fused under pressure without evolution of carbonic anhydride, and that the mass obtained on cooling was identical with marble. He moreover determined the pressure by mechanical means, and found it to be about 51 atmospheres. His numerous experiments were made partly in strong gun-barrels, and partly in tubes drilled out of wrought-iron; the carbonate of lime, usually enclosed in platinum, was first inserted, the remainder of the tube, after the introduction of a little borax, being filled with a fusible metal which solidified and firmly closed the apparatus. The end containing the carbonate was then heated in a furnace whilst the other was kept cool.

Nothing more was done in this direction until Grove proved that water was decomposed at a temperature below that produced by the union of oxygen and hydrogen: this is the germ of the principle of dissociation.

Dr. Robson, of Armagh, some time afterwards, inferred by the variation in the electromotive force that the relations between the elements in water were changed at a comparatively low temperature, and calculated that at about 2000° C. water would be split up into oxygen and hydrogen.

The next great step was made by Deville, who, when working with the oxyhydrogen furnace, measured the temperature produced, and found that it was much less than that theoretically obtainable. His well-known experiments on the instability of compounds at high temperatures, proved that the decomposition of carbonic anhydride, carbonic oxide, water, hydrochloric acid, &c., took place at a certain temperature, and, as the temperature was lowered, combination again occurred. By passing the vapour of water through a narrow porous tube, and carbonic anhydride through the annular space between it and a larger outer tube of glazed earthenware strongly heated, the aqueous vapour was partly decomposed, and the hydrogen diffused into the atmosphere of carbonic anhydride in the outer tube. Similarly, carbonic anhydride passed over fragments of intensely-heated porcelain is partly resolved into carbonic oxide and oxygen. The decomposition of carbonic oxide was shown by passing a stream of cold water through a narrow metal tube, and carbonic oxide through the annular space between it and the larger exterior porcelain tube intensely heated in a furnace. Carbon was deposited on the lower part of the metallic tube. By means of a similar apparatus, the decomposition of hydrochloric acid and sulphurous anhydride was also proved. These decompositions, which take place at a temperature of from 1200° to 1400° C., merely afford, however, a proof that heat acts antagonistically to chemical attraction, but do not give any relation between the temperature and the amount of decomposition. This was attained by Debray by a modified form of the experiment of Hall on carbonate of lime. Instead of registering the pressure at the fusion-point of the carbonate, he heated calc-spar in a vacuum, in an iron tube, to a constant temperature. At the boiling-point of mercury or sulphur, 300° to 400° C., there was no perceptible decomposition, but, on increasing the temperature to 800° C., the boiling-point of cadmium, decomposition sets in and increases until the evolved carbonic anhydride has a tension of 85 m.m. On increasing the heat to 1040° (in the vapour of zinc), more carbonic

anhydride is evolved until the pressure is 520 m.m. On again allowing it to cool to 800°, the tension diminishes to 85 m.m., and then remains constant. When cold, of course, all the carbonic anhydride is again re-absorbed. This shows a definite relation between the amount of decomposition and the temperature, or that the tension of dissociation is a function of the temperature. It is, moreover, the same whether there is much or little calcium carbonate in the experimental tube, and is, therefore, quite independent of the mass.

From that time a continually increasing number of observations have been made. Those on the compounds of ammonia with silver chloride and calcium chloride are more manageable, as these substances decompose more readily and at a lower temperature. A complete series of experiments has been made on the silver compound, and the curve representing the tension at different temperatures is sensibly parallel to that of the tension of aqueous vapour, showing that the law of dissociation for this compound is similar to that of the vapour tension of water.

By the dynamical theory of heat, there is a definite relation between the pressure, the latent heat, and the temperature, and the mechanical equivalent of any small alteration of volume can therefore be represented by an equation. The mechanical equivalent, or the heat required to boil or volatilise a liquid, may be derived from the equation—

$$L = T(V - v) \frac{dp}{dt}$$

L being the latent heat, T the temperature, V and v the different volumes, and dp and dt the alteration in pressure and temperature. Similarly, the latent heat of the vapour can be calculated from the tension. Rankine has shown that the equation—

$$\log. P = A - \frac{B}{t} - \frac{C}{t^2}$$

represents all curves of liquids, where P is the pressure, t the temperature, and A , B , and C are constants. As the latent heat of vapours can be calculated from the tension, it follows that in dissociation when the chemical compound is decomposed, the heat absorbed, L , which is equivalent to the heat evolved in their formation, can be calculated from the tension. Curves of tension are very difficult to obtain accurate, the simplest form of this equation being—

$$\log. \left(\frac{P_1}{P_2} \right) = \frac{J.L.d_0}{P_0} \cdot \frac{a(T_2 - T_1)}{(1 + at_2)(1 + at_1)}$$

where P_1 and P_2 are two pressures, J the Joule equivalent, L the latent heat, d_0 the density at 0° C., P_0 the pressure at 0° C., a the coefficient of expansion of the gas or vapour, and T_1 , &c., the temperatures.

Debray's observations on the evolution of aqueous vapour by certain hydrated salts, such as the two hydrates of sodium phosphate—namely, the one with 12H₂O, and the one with 7H₂O—show that the compound decomposes in a manner similar to calcium carbonate, giving off water vapour of a constant tension for a constant temperature. From an observation of the curves representing the tension, it appears that the one with 12H₂O behaves like a compound of water with the salt containing 7H₂O, the latter, however, still giving off aqueous vapour, but at a lower tension for a given temperature. The curves of both these hydrates are comparable with the curve of aqueous vapour. The vapour tension of salts containing water of crystallisation thus affords a means of determining the several hydrates which any salt is capable of forming.

Regnault has made careful determinations of the tension of liquefied carbonic anhydride, sulphuretted hydrogen, ammonia, and sulphurous anhydride for various temperatures, and also of the latent heat of carbonic anhydride and ammonia by the evaporation of the liquids. The latent heat, calculated from the vapour tension between -25° C. and +45° C., corresponds very closely with that observed directly. The lecturer had made an attempt to

directly determine the latent heat of mercury vapour by passing it into water contained in a calorimeter, but the difficulties attendant on the investigation prevented his obtaining very concordant results. The numbers obtained gave the latent heat at between 70 and 80 units. In the decomposition of cyanuric acid into cyanic acid, it was found that, up to 400° C., as the temperature rises, the tension of the vapour increases in a certain definite ratio, cyamelide giving a curve of similar type. The lecturer also described the curves representing the tension for the transformation of paracyanogen into cyanogen, that of ordinary phosphorus, and of the limiting pressures of the red allotropic form of phosphorus. In the latter case, the difference of the latent heats is equivalent to the evolution of heat in the transformation of the one allotropic form into the other.

One of the most recent and interesting investigations was that of the dissociation of hydrogenium. It has been found that Graham's compound of palladium and hydrogen, containing two equivalents of the former to one of the latter, is stable. When heated it gives a definite tension for a definite temperature, and this is independent of the mass. If, however, it is charged with more hydrogen than this the tension varies. In the latter case the compound may be regarded as a solution of hydrogen in the compound Pd₂H. This affords an interesting instance of the use of dissociation to ascertain whether a substance is a definite chemical compound or not.

It must be observed that there is continuity in the effects of dissociation, whereas chemical compounds proceeded by abrupt jumps. For instance, there is no continuity between the various oxides of any metal, each is well-defined, with a break between it and the next oxide.

The speaker concluded his able and interesting discourse with a description of an apparatus he had devised for ascertaining the temperature produced when a mixture of oxygen and hydrogen was exploded under various pressures.

The lecture was illustrated by numerous diagrams of curves corresponding to the tension of dissociation of the various compounds.

The PRESIDENT said it was needless to ask the Fellows to give formal expression to their thanks to Mr. Dewar for his admirable lecture. It would be of great interest to investigate the tension of dissociation of those bodies which, like oil of vitriol, gave anomalous vapour-densities.

Professor FOSTER thought it was one of the great advantages of a lecture like the present, in contradistinction to the usual papers, that it treated of matters lying outside the ordinary field of chemistry. There was very much to be done on the border-land between chemistry and purely physical science.

Mr. NORMAN LOCKYER said some of the remarks of the lecturer had seemed familiar to him from their resemblance to certain observations he had made in his spectroscopic work, and suggested that chemists should study the spectra of the metalloids and metals, especially the soda metals, paying particular regard to the relation between the temperature and the appearance of given lines.

Mr. DEWAR, in answer to a question by Dr. Wright, said that there were certainly cases which were exceptions to the rule that the dissociation was greater the less the pressure, but the number known was very small compared with those that followed the general law.

The meeting was then adjourned until Monday, March 30, the anniversary meeting. The next general meeting will be on Thursday, April 2, when the following papers will be read:—(1) "On Sulphocyanide of Ammonium and Sulphocyanogen," by Dr. T. L. Phipson. (2) "Note on a Reaction of Gallic Acid," by H. R. Procter. (3) "On the Cobalt Bromides and Iodides," by W. Noel Hartley. (4) "On the Distillation of Sodium Ricinoleate," by E. Neison. (5) "Note on the Solubility of Plumbic Chloride in Glycerine," by H. Piesse. (6) "On Ozone as a Concomitant of the Oxidation of the Essential Oils, Part I.," by C. T. Kingzett. (7) "Action of Benzyl Chloride on Camphor, Part II.;" (8) "Researches on the

Preparation of Organo-metallic Bodies of the C_nH_{2n} series of Hydrocarbons;" and (9) "Action of Benzyl Chloride on Alcohol," by Dr. D. Tommasi.

PHYSICAL SOCIETY OF LONDON.

THE first ordinary meeting of the Physical Society of London was held in the Science Schools, South Kensington, on the 21st inst., Dr. Gladstone, F.R.S., in the chair.

The CHAIRMAN gave a brief description of the objects and organisation of the Society, and announced that ninety-nine gentlemen had already expressed their desire to join the Society as original members.

Mr. J. A. FLEMING, B.Sc., read a paper on the "Contact Theory of the Battery." After discussing the most recent views regarding the contact and chemical theories, Mr. Fleming exhibited the action of his new battery, in which metallic contact of dissimilar metals is completely avoided. The battery consisted of thirty test-tubes of dilute nitric acid alternating with the same number of tubes of penta-sulphide of sodium, all well insulated. Bent strips of alternate lead and copper connected the neighbouring tubes. By this device, the terminal poles are of the same metal. On connecting with a coarse galvanometer, the needle was violently and permanently deflected. Tested by the quadrant electrometer, the potential was shown to increase regularly with the number of cells. The sixty cells on first immersion showed a potential exceeding that of fourteen Daniell's cells. The principle upon which the action depends is that, in the acid, lead is positive to copper; in the sulphide it is negative. Mr. Fleming further showed how, by using the single liquid, nitric acid, and the single metal, iron, a similar battery could be constructed, provided one-half of each iron strip were rendered passive. In this form, also, no metallic contact occurred.

Prof. F. GUTHRIE exhibited experiments illustrating the distribution of a galvanic current on entering and leaving a conducting medium. This was shown in the case of solids by the stratification of iron-filings on sheets of copper and lead. The effect of the distribution on a magnetic needle which is hung near a conducting vertical sheet in the magnetic meridian—into the upper horizontal edge of which a current enters, and out of which it passes at the same elevation—is to alter the direction of the needle's direction of turning, according as the needle is lowered or raised. At a distance from the upper edge of one-third the distance of the interval between the poles, the needle is at rest. A similar effect was shown in a liquid conductor.

Prof. Foster, Dr. Wright, and Dr. Gladstone took part in the discussion of the communications.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

Ordinary Meeting, February 26th, 1874.

Dr. LUNGE, President, in the Chair.

The following paper was read by Mr. J. PATTINSON:—"On the Rate at which Bleaching-Powder Loses its Available Chlorine." In dealing commercially with an article of such vast importance as bleaching-powder, unstable in its composition, and the value of which is determined by the amount of chlorine it contains in a condition available for bleaching purposes, the question naturally very often arises—"How much available chlorine does it lose in a given time?" The examination of a number of samples of bleaching-powder, from time to time, during about twelve months, the results of which are given below, was undertaken with the view of making a contribution towards the solution of this question, and also to the further one—"Does weak bleaching-powder, say containing about 32 per cent of chlorine, retain its strength better than a stronger bleaching-powder?"

The samples examined were made by what is now known as the old process, in which the chlorine is generated in the ordinary stone stills by the action of hydrochloric acid on native peroxide of manganese. Three sets of samples were obtained from different manufactories on the Tyne, each set consisting of three samples. It was intended that the three samples of each set should be taken from the same portion of lime—one when it contained about 33 per cent of available chlorine, one when it contained about 35 per cent, and the third when it contained about 37 per cent—and with this object the lime was placed in a box in the chlorine chamber, so that it could be easily removed in order to take out the samples at each stage. The samples marked "No. 1" were first taken, then the boxes containing the remainder of the lime were replaced in the chambers to absorb more chlorine. The samples marked "No. 2" were then taken, and the boxes again replaced in the chambers to receive more chlorine, when the "No. 3" samples were taken. The samples obtained, although not exactly of the strengths wished, are perhaps sufficiently near for the required purpose. They were placed in glass bottles holding about half a pound, and kept in these, loosely corked, in a room where they were never exposed to the direct rays of the sun. At first they were tested about once a week, afterwards once a fortnight, and ultimately once a month during the last six months.

The process used for testing was that known as Penot's process, in which an alkaline solution of arsenious acid, with iodised starch-paper as indicator, is employed.

The following tables give the percentages of available chlorine in the various samples on the dates named:—

		A 1.	A 2.	A 3.
January	20, 1873 ..	28.7 %	37.4 %	37.1 %
"	28, " ..	28.5	37.3	36.8
February	4, " ..	28.4	37.1	36.6
"	12, " ..	28.3	37.1	36.4
March	22, " ..	28.2	36.7	36.0
"	31, " ..	27.7	36.6	35.8
April	14, " ..	27.7	36.6	35.8
"	24, " ..	27.7	36.5	35.8
May	6, " ..	27.6	36.4	35.7
"	24, " ..	27.3	36.0	35.2
June	18, " ..	26.5	35.4	34.6
July	4, " ..	26.0	35.1	34.3
August	8, " ..	24.5	33.8	33.2
September	8, " ..	23.5	33.3	32.3
October	27, " ..	22.6	32.3	30.9
November	19, " ..	—	32.2	30.9
February	3, 1874 ..	20.8	31.2	30.2
		B 1.	B 2.	B 3.
December	11, 1872 ..	32.9 %	35.2 %	36.7 %
"	21, " ..	32.6	34.8	36.4
January	2, 1873 ..	32.4	34.6	36.1
"	18, " ..	32.2	34.4	35.9
"	28, " ..	32.0	34.2	35.7
February	4, " ..	31.8	34.2	35.4
"	12, " ..	31.6	34.2	35.4
March	22, " ..	31.6	34.2	35.3
"	31, " ..	31.3	34.2	34.8
April	15, " ..	31.3	34.0	34.7
"	24, " ..	31.2	34.0	34.6
May	6, " ..	31.0	33.9	34.5
"	26, " ..	30.4	33.4	34.2
June	18, " ..	30.0	32.9	33.3
July	4, " ..	29.6	32.3	33.0
August	8, " ..	27.9	31.3	31.6
September	8, " ..	26.8	30.3	30.8
October	27, " ..	—	29.0	29.8
November	19, " ..	—	28.3	29.0
February	3, 1874 ..	22.2	27.9	28.0
		C 1.	C 2.	C 3.
January	20, 1873 ..	31.8 %	37.6 %	37.6 %
"	28, " ..	31.6	37.5	37.6
February	4, " ..	31.4	37.4	37.4
"	12, " ..	31.4	37.2	37.4

		C 1.	C 2.	C 3.
March	8, 1873 ..	31.4	37.2	37.4
"	22, " ..	31.4	37.0	37.3
"	31, " ..	31.0	36.7	37.0
April	15, " ..	30.8	36.5	37.0
"	24, " ..	30.8	36.4	36.9
May	6, " ..	30.7	36.2	36.9
"	24, " ..	30.5	35.9	36.5
June	18, " ..	30.2	35.0	36.0
July	4, " ..	29.7	34.3	35.8
August	8, " ..	28.6	32.5	34.3
September	8, " ..	27.8	31.5	34.3
October	27, " ..	27.3	30.2	33.2
November	19, " ..	26.9	29.8	32.9
February	3, 1874 ..	26.4	28.2	32.3

There were but very small quantities remaining of the samples marked "A 1" and "B 1" on February 3, 1874, and this may account for the exceptionally large loss of chlorine between this date and the date of the previous testings. I have therefore excluded these results in calculating the averages given in the following tables.

On examining the above tables it will be seen that, as might have been anticipated, the loss of chlorine is greater in the warm summer months than in the winter months. The following table shows the total loss of chlorine during the three months ending April 24, the three months ending September 8, and the three months ending February 3, 1874:—

	3 Months ending April 24.	3 Months ending Sept. 8.	3 Months ending Feb. 3, 1874.
A 1 ..	1.0 %	3.0 %	— %
A 2 ..	0.9	2.1	1.0
A 3 ..	1.3	2.3	0.7
B 1 ..	1.0	3.2	—
B 2 ..	0.4	2.6	0.4
B 3 ..	1.3	2.5	1.0
C 1 ..	1.0	2.4	0.5
C 2 ..	1.2	3.5	1.6
C 3 ..	0.7	1.7	0.6

The average loss of chlorine, taking the whole of the samples into account, was, during the three months ending April 24, 0.33 per cent per sample per month; during the three months ending September 8, 0.86 per cent per month; and during the three months ending February 3, 1874, 0.28 per cent per month. The greatest loss in any one month was in the month ending August 8, when the samples lost as follows:—

A 1 ..	1.5 %
A 2 ..	1.3
A 3 ..	1.1
B 1 ..	1.7
B 2 ..	1.0
B 3 ..	1.4
C 1 ..	1.1
C 2 ..	1.8
C 3 ..	1.5

The average loss for this month being 1.4 per cent of chlorine, taking the whole of the samples into account.

The following table shows the average loss of chlorine per month in each sample during the whole time each sample was tested:—

A 1 ..	0.68 %
A 2 ..	0.52
A 3 ..	0.58
B 1 ..	0.68
B 2 ..	0.60
B 3 ..	0.72
C 1 ..	0.50
C 2 ..	0.90
C 3 ..	0.50

The average loss per month is 0.63 per cent.

The total loss of available chlorine in each sample from January 20 to September 8, a period of about eight

and a half months, during which all the samples were tested, was as follows:—

A 1 ..	5.2 %
A 2 ..	5.1
A 3 ..	4.8
B 1 ..	5.4
B 2 ..	4.1
B 3 ..	5.1
C 1 ..	4.0
C 2 ..	6.1
C 3 ..	3.3

On examining the above tables it will be seen that, with reference to the question as to the relative stability of weak and strong bleaching-powder, there is practically no difference in the rate at which they lose available chlorine. The weak 28.7 per cent bleaching-powder loses its strength at about the same rate as the 37 per cent samples.

These results are not presented as definite answers to the questions with which I set out, but only as a small contribution to what is necessarily a very wide and somewhat complicated inquiry. Whether the loss of strength goes on in the same ratio in large masses in casks as it has done in the comparatively small quantities I had in bottles; the effect of using lime containing various amounts of water of hydration; the influence of different temperatures in the chamber during the time chlorine is being absorbed; and various other conditions affecting the stability of bleaching-powder, all require investigation. Whether the bleaching-powder made by the Deacon process keeps better than that made by the old process, as is sometimes asserted, is a question I should also like to see examined. I trust that some of our members, who have more time and better opportunities than I have, will take up the investigation of some of these points, and give to the Society the result of their inquiries.

The PRESIDENT said it would be interesting to enquire more fully as to (1) whether, under all circumstances, weak and strong bleach lost strength at the same rate; (2) whether, as was believed by many, shaking in transit accelerated the loss. He hoped the subject would be further pursued.

Mr. LOMAS thought the loss depended partly upon the rapidity with which the bleach was made, and partly on the way in which it was packed, which might make a difference of 1 per cent.

Mr. GLOVER suggested that some of the younger members might advantageously devote themselves to the study of the exact states of combination in which chlorine exists in bleach.

Mr. PATTINSON said this question had formed part of the inquiry which he had proposed to undertake, but the results, in this direction, were hardly ready for publication.

The PRESIDENT promised to bring forward some extracts from Continental authorities on the discussion of the paper.

CORRESPONDENCE.

VALUATION OF SALT-CAKE OR CRUDE SULPHATE OF SODA.

To the Editor of the Chemical News.

SIR,—I have frequently had occasion to observe the considerable differences in the results of analyses of identical samples of salt-cake by different analysts of repute. That these differences are not due merely to unavoidable "errors of analysis" is evident from the fact that certain chemists invariably give results from 1 to 3 per cent higher than certain others. The true explanation appears to lie in the various methods employed, and I have thought a consideration of those processes likely to be useful. The following represents the composition of an average sample:—

Sulphate of soda	95.25
Sulphate of lime	1.25
Chloride of soda	1.75
Sulphuric acid (free)	1.00
Silica and ferric oxide	0.50
Moisture	0.25

100.00

The method which seems the one best calculated to give the true composition of such a sample is as follows:—The free H_2SO_4 and undecomposed NaCl are determined by standard solutions of carbonate of soda and nitrate of silver respectively; sulphate of lime, by oxalate of ammonia; silica and peroxide of iron, by precipitation by ammonia or acetate of soda; and moisture, by drying at 100°C .

Another method, which is favoured by the "high" analyst, differs from the above, inasmuch that the "free acid and moisture" are estimated together by the loss of weight on ignition or roasting of a sample. Now it is clear that the result of ignition must be that a portion of the free H_2SO_4 will react on part of the NaCl , forming Na_2SO_4 and liberating HCl . Thus the analyst performs a manufacturing operation in the process of his analysis, and his "results" represent a higher percentage of Na_2SO_4 than is really present in the original sample. And the amount of this error varies with the composition of the sample.

In order to obtain a greater uniformity in the results of analysis of this substance, it seems desirable that chemists should agree as to the most proper analytical processes to be employed; and I have offered these remarks in the hope to elicit the views of others on the subject.—I am, &c.,

WALTER TATE.

Dublin, March 23rd, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, February 2, 1874.

Irrigation Canal from the Rhone.—M. Dumont.—The Conseil General des Ponts et Chaussées have pronounced favourably on the project, and it is now being submitted to an enquiry of public utility in the five departments concerned. The canal will allow of irrigating or submerging a surface of 80,000 hectares; two-thirds of which consist of rich vineyards, nearly all ravaged by the Phylloxera.

Note on Magnetism.—M. Jamin.—Reply to M. Gauguin.

Direct Demonstration of the Equation $\int \frac{dQ}{T} = 0$ for every Cycle, Closed and Reversible. (Concluded.)—M. Ledieu.

History of the Question of the Gliding of a Bird in the Air.—M. Penaud.—The author finds the views expressed by M. Marey to be of much older date.

Trepidations of the Ground at Nice.—Letter from M. Prost.

Apparent Orbit and Period of Revolution of the Double Star ζ of Hercules.—M. Flammarion.

Variable State of Voltaic Currents.—M. Blaserna.—Reply to M. Cazin.

New Saccharimeter, and a Means of Rendering the Flame of Sodium quite Mono-Chromatic.—M. Laurent.—The novelty consists in a thin cleft plate of gypsum covering the half of a diaphragm between the

polariser and the analyser. Placed between two Nicols, the principal sections of which are perpendicular, this plate gives yellow corresponding to the sodium line D, whether with white or with yellow light. If the Nicols have their sections parallel, with white light, the complementary colour, blue-violet, is obtained; with yellow light, black. The plate produces very simply the effect of a polariser in two parts, of which the principal sections make a certain angle with each other, and this can be readily varied from zero to 45° , which is convenient in some applications; thus a given liquid being more or less discoloured one may choose the angle which will give maximum precision. To render the sodium flame monochromatic M. Laurent interposes between flame and polariser a plate of cleft bichromate of potash, which absorbs the violet and blue rays, and part of the green, in the sodium flame; rays which diminish the precision where the equality of shades is to be pronounced upon.

New Laboratory Balance.—M. Deleuil.

Researches on the Outflow of Liquids from Capillary Tubes.—M. Gueront.—The author verified Poiseuille's law, and studied the internal constitution of the liquid column in the tube during outflow. He applied at the lower mouths of the tubes, successively, several thin ivory diaphragms, with an aperture smaller than that of the tube. It was thus shown that, with the same aperture of diaphragm, the outflow is more rapid the larger the tube to which the diaphragm is fitted. Next, applying to the same tube diaphragms with different apertures, the velocities were found greatest with orifices the most distant from the walls of the tube. The results are explained by supposing that the liquid moves in the tube by concentric cylindrical layers, having velocities which are greater as the diameters are less. Some exceptions to this M. Gueront proposes to discuss in another note.

Supposed Liberation of Ozone by Plants.—M. Bellucci.—The author passed air containing 1-100th of its volume of carbonic anhydride for six hours, in the day-time, through a glass tube, part of which was covered with black paper, to a receiver enclosing living plants, whence it issued by a second like tube. In each of the tubes were placed two ozonoscopic papers. Now it appears that the papers in the dark parts of both tubes were quite unaltered; and the change in the others could only be produced by ozone existing in the air which traversed the apparatus. The intensity of colouration of the paper exposed to light in the second tube almost exactly corresponded to that of the paper in the illuminated part of the first tube; thus excluding the supposition that the chemical activity of the air was due to ozone produced by the plants. The author thinks M. Cloëz's view confirmed, according to which the combined action of humid oxygen and solar light accounts for the colouration of iodised starch-paper, independent of ozone.

Conditions under which Lead is Attacked by Water.—M. A. Bobierre.

Remarks Relative to the Foregoing Communication.—M. Belgrand.

Action of Water, Ordinary and Distilled, also of Distilled Sea-water upon Lead, and upon the Tin Condensers of the Apparatus for Distillation.—M. L. Besnou.—These three papers all refer to the effects of leaden service-pipes used in the water supply of towns—a subject which is receiving at present much attention in Paris. The results obtained agree with those of former experimentators.

Lateral Solfataras of the Volcanos of Chili and on Certain New Minerals.—M. T. Domeyko.—The author describes two classes of solfataras; the former open in elongated rifts, and throw out enormous masses of shattered rocks, producing trachytic conglomerates; they emit jets of gas and steam for a short time, and leave scarcely any deposits of sulphur. Those of the second class are permanent, their emissions of gas and steam are

slow and continuous, and they yield large quantities of sublimed sulphur. The author mentions certain novel minerals which he has presented to the museum of the Ecole des Mines, but the descriptions and analyses are not given.

Oxalurate of Ethyl, and the Cyanurate of Oxamethan.—M. E. Grimaux.—The author, attempting to convert oxamethan into oxalurate of ethyl by the action of cyanic acid, obtains a body possessing the composition of the oxalurate sought for, but which on further examination proved to be an isomer, the cyanurate of oxymethan.

Ammoniacal Fermentation of Urine.—M. A. Lailler.—The author mentions certain diseases of the nervous system in which the urine is strongly ammoniacal at the time of its emission.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin,
No. 20, January 12, 1874.

Constitution of the Dibrom-Benzols.—C. Wurster.—The author undertook a complete investigation of the solid and of the two liquid varieties of dibrom-benzol. He considers that Reise's dibrom-benzol, in so far as it is distinct from meta-dibrom-benzol, must belong to the ortho series. He obtained tribrom-benzol from dibrom-anilin, and dibrom-anilin from nitro-dibrom-benzol.

Nitro Compounds of the Fatty Series.—Victor Meyer.—This paper, the author's seventh communication on the same subject, is not well adapted for abstraction.

"Continuing Rays" of Becquerel.—Hermann Vogel.—In 1843 Becquerel published observations according to which the red, yellow, and green rays, though chemically inactive *per se*, are capable of keeping up action which has been communicated by the chemically active rays (*Annales de Chimie et Physique*, Nov., 1843). Becquerel appears to have experimented with impure bromide and iodide of silver. His statements were contested by Draper. Claudet obtains diverse, mutually-conflicting results. Guetzlaff has recently revived Becquerel's view, and has recommended to give photographic plates, after a short exposure, a supplementary exposure under glass coloured so as to cut off the blue end of the spectrum. The author, along with Zencker and Prümm, investigated this point in the course of last summer, and found that in case of the ordinary brom-iodo silver process a supplementary exposure under red glass was perfectly inoperative. The author explains the apparently continued action of red and yellow light upon chloride of silver in another manner. Pure white chloride of silver, (AgCl), is sensitive to the violet and ultra-violet rays only, but by these it is reduced to the violet subchloride, (Ag_2Cl), which as Seebeck, Herschel, Poitevin, and others have shown, is sensitive to almost every ray of the spectrum. When Becquerel exposed chloride of silver paper for a short time to daylight "till a slight commencement of action was perceptible," a small quantity of the violet chloride of silver would necessarily be formed. As this compound is sensitive to red and yellow rays we cannot wonder that these exerted their action.

On Diphenyl-ethan.—Guido Goldschmiedt.—Diphenyl ethan has been obtained in a state of perfect purity by the reduction of diphenyl-trichlor-ethan.

On Hellenin and Alant Camphor.—J. Kallen.—The author finds that Gerhardt's hellenin is a mixture of two distinct bodies, true hellenin and a camphor-like body, which he names alant camphor. The former is $\text{C}_6\text{H}_8\text{O}$, the latter $\text{C}_{10}\text{H}_{14}$.

Chemical Constitution of Chloride of Lime.—C. Schorlemmer.—The author contests the view of Berthollet, recently revived by Goepner, that the bleaching compound contained in chloride of lime is not a hypochlorite, but a direct compound of lime and chlorine.

Miscellaneous Communications.—V. Merz and W. Weith.—The authors have been experimenting on diphenylamin and its derivatives, on the sulpho acids of

diphenylamin, on triphenylamin, and on the behaviour of sodium ethylate when heated. Following up the observation of Wanklyn that bright sodium remains unattacked even if gently heated in a current of dry chlorine, they have examined the comparative reactions of sodium and potassium with bromine, iodine, aniline, &c., and find sodium little affected, whilst potassium reacts violently.

Contributions towards Establishing the Position-Formulae of the Allyl Compounds and of Acrylic Acid.—E. Linnemann.—From this lengthy paper we extract merely the inference "that acrolein is either not the true aldehyd of acrylic acid, or that the formula deduced from that of the normal fatty bodies is wanting for one of the two; or, lastly, that neither acrolein nor acrylic acid are constituted analogously, either to the aldehyds, or to the fatty acids.

Certain Tables of Affinity.—Julius Thomsen.—Incapable of abstraction.

Remarks on J. Thomsen's Paper "On the Influence of Temperature on the Chemical Development of Heat."—L. Pfaundler.—A critique on Prof. Thomsen's paper which appeared in *Berichte*, vol. vi., p. 1335.

Action of Cyanide of Potassium upon Croton-Chloral.—O. Wallach and A. Bœhringer.—The result of the reaction is mono-chloro-crotonic ether.

Certain Derivatives of Liquid Dibrom-Benzol.—C. Wurster.—This paper consists chiefly of hypothetical formulae.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, September and October, 1873.

Composition of Lithion Mica.—J. Rammelsberg.

New Series of Diamines which occur as Secondary Products in the Manufacture of Methylanilin.—A. W. Hofmann and Martius.

Violet Colour-Derivatives of Methylanilin.—A. W. Hofmann.

Violet Derivatives of Rosanilin.—A. W. Hofmann.

NOTES AND QUERIES.

Estimation of Nitrogen.—Will any of your readers kindly give me a method of estimating nitrogen existing in nitrate of soda in the presence of nitrogenous organic matter and sulphate of ammonia?—STUDENT.

Boiling Litharge, &c.—Will any of your readers kindly inform me my best way to boil the following ingredients into a white mass—namely, litharge, 54"; olive oil, 10"; water, a sufficiency to boil, say, four or five hours, or anything that will bleach the above white.—W. M. M.

Small Motive-Power.—If it were possible to devise a small machine fulfilling every requirement, to be worked by any convenient power, to agitate certain solutions in chemical analysis—as, for instance, to promote the formation of the double phosphate of magnesia and ammonia, thus saving the laborious process of hand-stirring, and consequent liability to breaking of beakers, &c.,—would such a machine be acceptable to the profession of analytical chemists generally?—H. H. H.

MEETINGS FOR THE WEEK.

MONDAY, March 30.—Medical, 8.
— London Institution, 4.
— Chemical, 8. Anniversary.
TUESDAY, 31.—Civil Engineers, 8.
WEDNESDAY, April 1.—Microscopical, 8.
— Pharmaceutical, 8.
THURSDAY, 2.—Chemical, 8.

TO CORRESPONDENTS.

Delta.—Plateau's papers in the *Philosophical Magazine*.
A. G. Phillips, G. E. Webster, and others.—We cannot see that any useful object will be gained by continuing the discussion.
J. H. S.—We do not know.
Chemist.—Consult a professional chemist. The reply would be too long for our "Answers to Correspondents" column.

THE CHEMICAL NEWS.

VOL. XXIX. No. 749.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.
(Continued from p. 138).

CALCULATION OF VACUUM-WEIGHT OF GLASS APPARATUS + NITRATE OF THALLIUM FROM GIVEN DATA.

First Weighing in Air of Ordinary Density.

By Table A,

$$\log. \frac{0.00129381}{1 + 0.03656t} \cdot \frac{1}{780} \text{ for } 22.7^\circ \text{ C.}$$

$$t \ 22^\circ \text{ is } 4.197488 - 10$$

$$t \ 7 \text{ is } 1027$$

$$4.198515 - 10$$

By Table B,

$$0.378\frac{2}{3}v \text{ for } t = 22.7 = 5.17 \text{ millims.}$$

$$759.22 - 5.17 = 753.05;$$

$$\log. (753.05) = (2.8768238 - 10) + 4.198515 =$$

$$\log. 7.0753388 - 10 = \log. \frac{\text{den. atmos. air}}{\text{max. den. water}}$$

Second Weighing in a Rare Atmosphere.

By Table A the value of

$$\log. \frac{0.0012938}{1 + 0.00365t} \cdot \frac{1}{768} \text{ for } t = 21^\circ \text{ C.} =$$

$$= (4.198959 - 10) + 2.0532321 = 6.2521911 - 10 =$$

$$\log. \frac{\text{den. rare air}}{\text{max. den. water}}$$

Value of $0.378\frac{2}{3}v$ for $t = 21^\circ \text{ C.} = 4.66$ millims.:

$$117.70 \text{ millims. (pressure)} - 4.66 = 113.04 = p' - 0.378\frac{2}{3}v,$$

$$\log. b' = 1.6834703 + 6.2521911 - 10 = 7.9356614 - 10;$$

$$\therefore .0086231 = z = \text{weight of rare air displaced by } \gamma.$$

The data now are—

$$w = 1005.425937,$$

$$x = 0.059140,$$

$$y = 1005.726438,$$

$$z = 0.0086231,$$

$$\log. \frac{l}{k} - 6.2521911 - 7.07653388 = 9.1768523 - 10.$$

$$\text{Hence } n = \frac{l}{k} = .15026:$$

$$1 - n = .84974,$$

$$y - w = 1005.726438 - 1005.425937 = .300501,$$

$$x - z = .059140 - .008623 = .050517;$$

$$\therefore m - y - w + x - z = .351018.$$

$$k = \frac{m}{1 - n} = \log. .351018 - \log. .84974 = .5453418 - .9292861 =$$

$$.6160557 = k = .4131,$$

$$w - x = 1005.425937 - .059140 = 1005.366797.$$

$$(w - x) - k = 1005.366797 - .4131 = 1005.779897 = h = \text{true weight of glass apparatus plus nitrate of thallium in vacuo.}$$

$$1005.779897 - 766.133831 \text{ (weight of glass apparatus in vacuo)} = 239.646066 = \text{weight of nitrate of thallium in vacuo.}$$

$$239.646066 - 239.611359 \text{ (weight of nitrate of thallium in air)} = .034707 = \text{increase in weight for vacuum.}$$

* A Paper read before the Royal Society June 20, 1872.

WEIGHT OF THALLIUM.*

$$\text{Weight of thallium taken} \dots = 183.783921$$

$$\text{Air displaced by thallium} \dots = 0.012596$$

$$\text{Deduct air displaced by weights} \dots = 0.012596$$

$$\text{True weight of thallium in vacuo} \dots = 183.790232$$

$$\begin{aligned} \dagger \text{True weight of thallium in vacuo} &\dots = 183.790232 \\ \text{" " nitrate of thallium in vacuo} &= 239.646066 \\ \text{" " glass in vacuo} &\dots = 766.133831 \end{aligned}$$

The reduction of the atomic weight from data obtained in the manner of the preceding weighings becomes a case of simple proportion; but the values found are absolute in so far only as the atomic weights of nitrogen and oxygen are correct. The atomic weights of nitrogen and oxygen have been usually represented by the numbers 14 and 16; but Professor Stas found these elements represented, according to observation, by 14.009 and 15.960. Therefore, oxygen (O_3) = 47.880, and nitrogen = 14.009, or NO_3 = 61.889. According to the old equivalents, NO_6 = 62.

Taking as data the series of weighings in vacuo, the quantity of NO_3 required to convert the thallium into nitrate is—

$$(239.646066 - 183.790232) = 55.855834 \text{ grms.}$$

We have, then, with Professor Stas's determination of the atomic weights of nitrogen and oxygen, the following proportion:—

$$\begin{array}{cccc} \text{Weight of} & \text{Weight of} & \text{Atomic weight} & \text{Atomic weight} \\ \text{NO}_3 & \text{thallium.} & \text{of NO}_3 & \text{of thallium.} \\ 55.855834 & : 183.790232 & :: 61.889 & : x; \\ & & \therefore x = 203.642. \end{array}$$

This number, it will presently appear, represents the atomic weight of thallium as nearly as the possibility of error will allow.

Let us see what would be the atomic weight of thallium if one or other of the corrections introduced into the above determination had been omitted. The use of the old equivalent (=62) for NO_6 , with the data derived from the weighings in vacuo, gives

$$55.855834 : 183.790232 :: 62 : 204.007$$

as the atomic weight; but I cannot admit this number to be so correct as 203.642.

If we take the corrected weighings in air of ordinary density, we have, with NO_3 = 61.889,

$$55.827438 : 183.783921 :: 61.889 : 203.738.$$

With NO_6 = 62,

$$55.827438 : 183.783921 :: 62 : 204.103.$$

Accepting the uncorrected weights observed in air, we have, with NO_3 = 61.889,

$$55.8184 : 183.8099 :: 61.889 : 203.800.$$

With NO_6 = 62,

$$55.8184 : 183.8099 :: 62 : 204.166.$$

The several atomic weights would therefore be

$$\begin{array}{cc} 203.642 & 204.007 \\ 203.738 & 204.103 \\ 203.800 & 204.166 \end{array}$$

The error of the last deduction, +.524, is sufficiently large to show the necessity of neglecting no precaution in chemical manipulation, especially in a determination of this character. The largeness of these errors has an immediate bearing upon quantitative analysis; for it shows that, from data ordinarily given, very varying results may be obtained. Chemists have to deal with much smaller quantities than a quarter per cent, particularly in organic analysis, where, as I have shown, such a difference from the truth may lead to very erroneous reasoning.

(To be continued).

* To save needless repetition, I only give the results of these calculations.

† In this determination, the thallium and afterwards the nitrate of thallium were weighed in the same glass apparatus as described.

PRELIMINARY NOTICE OF EXPERIMENTS CONCERNING THE CHEMICAL CONSTITUTION OF SALINE SOLUTIONS.*

By WALTER NOEL HARTLEY, F.C.S.,
Demonstrator of Chemistry, King's College, London.

THE author has been engaged in investigating the above subject during the last eighteen months, and his experiments being still in progress, he thinks it desirable to place the following observations on record:—

In the examination of the absorption-spectra, as seen in wedge-shaped cells, of the principal salts of cerium, cobalt, copper, chromium, didymium, nickel, palladium, and uranium, to the number of sixty different solutions, it was noticed that the tinctorial properties of the substances could be ascertained by noticing the absorption-curves and bands, so that, provided water be without chemical action, it could be foreseen what change would occur on dilution of a saturated solution.

The Effect of Heat on Absorption-Spectra.—When saturated solutions of coloured salts are heated to 100° C. there are—(1) few cases in which no change is noticed. (2) Generally the amount of light transmitted is diminished to a small extent by some of the more refrangible (the less refrangible), or both kinds of rays being obstructed. (3) There is frequently a complete difference in the nature of the transmitted light. Anhydrous salts not decomposed, hydrated compounds not dehydrated at 100° C., and salts which do not change colour on dehydration, give little or no alteration in their spectra when heated.

Solutions of hydrated salts, and most notably those of haloid compounds, do change; and the alteration is, if not identical, similar to that produced by dehydration and the action of dehydrating liquids, such as alcohol, acids, and glycerin, on the salts in crystals or solution.

A particular instance of the action of heat on an aqueous solution is that of cobalt chloride, which give a different series of dark bands in the red part of the spectrum at different temperatures, ranging between 23° and 73° C. Band after band of shadow intercepts the red rays as the temperature rises, till finally nothing but the blue are transmitted. Drawings of six different spectra of this remarkable nature have been made. The changes are most marked between 33° and 53°, when the temperature may be told almost to a degree by noting the appearance of the spectrum. Though to the unaided eye cobalt bromide appears to undergo the same change, yet, as seen with the spectroscopic, it is not of so curious a character, the bands being not so numerous.

With cobalt iodide a band of red light is transmitted at low temperatures; this moves towards the opposite end of the spectrum with rise of temperature until it is transferred to such a position that it consists of green rays only. In this instance the change to the eye is more striking when seen without the spectroscopic, because the mixtures of red, yellow, and green rays, which are formed during the transition, give rise to very beautiful shades of brown and olive green. Thus a saturated solution at 16° C. was of a brown colour, at -10° C. it became of a fiery red and crystals separated, at +10° reddish-brown, at 20° the same, at 35° Vandyke brown, 45° a cold brown tint with a tinge of yellowish green, at 55° a decidedly yellowish green in thin layers and yellow-brown in thick, 65° greenish brown, thin layers green, 75° olive-green. An examination of this cobalt salt has shown that there are two distinct crystalline hydrates; the one formed at high temperatures has the formula $\text{CoCl}_2 \cdot 2\text{H}_2\text{O}$, and is of a dark green colour; the other, which contains a much larger proportion of crystalline water, is produced at a low temperature, and its colour is generally brown, in cold weather inclining to red.

The action of heat on solutions of didymium is characterised by a broadening of the black lines seen in the

spectrum, more especially of the important band in the yellow; and in the case of potassio-didymium nitrate this is accompanied by the formation of a new line. In the case of didymium acetate, which decomposes with separation of a basic salt, the lines thickened on heating.

Thermo-Chemical Experiments.—Regnault (*Institut*, 1864; *Jahresbericht*, 1864, p. 99) has shown that on diluting a saturated solution of a salt, as a rule there is an absorption of heat, but in one or two cases he noticed that heat was evolved. The change in colour that takes place on the dilution of saturated solutions of cobalt iodide, cupric chloride, bromide, and acetate is very remarkable. There is every likelihood that this phenomenon is due in each case to the formation of a liquid hydrate. It is impossible of belief that accompanying such a circumstance there should be no measurable development of heat; and the author's experiments have proved that in the above cases, at any rate, the heat disengaged is very considerable; amounting, for instance, on the part of cupric chloride, at least to 2565 "units when 1 grm. molecule of the crystalline salt is displaced in its minimum of water at 16° C., and brought into contact with sufficient to make the addition of 40 Aq." These numbers only roughly approximate the truth. On diluting a solution of cobalt iodide till the red colour appears, the thermal effect must be greater, as not only does it register several degrees on an ordinary thermometer, but it may be perceived by the hand.

The conclusions indicated by these results are obvious, but it is beyond the scope of this paper to refer to them. The writer hopes before long to complete his experiments with the view of having them communicated to the Royal Society.

IMPROVEMENTS UPON EGGERTZ'S METHOD FOR DETERMINING COMBINED CARBON IN STEEL.

By EDWARD R. TAYLOR.

To relieve myself from the thralldom of monotonous routine work that would otherwise absorb nearly all my time the following improvements for the execution of Eggertz's method for determining carbon in steel were devised.

A balance, consisting of a very fine thread of glass, with a pan in two parts, one a cup and one a cone, serves to weigh the steel. A horizontal drill, with a glass tube to form a hopper, makes, and conducts the drillings of steel, as they are made, to the balance pan, which is properly supported about one-eighth of an inch above a point to which it settles, when a two hundred milligramme weight is placed in the pan. Being thus set a sample of steel is placed in the drill lathe, the drillings, as before mentioned, falling into the pan below. As soon as the two hundred milligrammes weight is in the pan, the pointer sinks to the index, when the drill is stopped. By passing a tube through a hole in the balance table, the lip of the tube offering a support for the balance cup, while the cone is pressed down with a pair of tweezers, the drillings at once fall into the tube, and are ready for treatment with acid.

A glass funnel is made, with a capillary opening at the contracted lower end. This is fused with a T tube, the lateral branch of which is passed through the window of the laboratory to remove the fumes. A rubber nipple is placed on the lower end of the T tube, into which the tube containing the steel is inserted. Three c.c. are now drawn into the funnel tube, and fall in drops upon the steel below. At the expiration of this action the tube is transferred to a bath kept at the temperature of 130° C.

At the end of twenty minutes from drawing in the acid, the operation is completed; the whole of the carbon has entered into a clear yellow solution, which has a depth of colour proportionate to the amount of combined

* A Paper read before the Royal Society.

carbon in the steel. The tubes are cooled down to a normal temperature, and compared with a series of standard colours, when it is easy to read off the amount of carbonised carbon in a given sample of steel.

The accuracy and ease of execution of this method leaves little to be desired, while it is of great value in ascertaining the amount of carbon in different specimens of steel, or the regularity of its diffusion in different parts of the same cast.

ON THE

METHODS IN USE FOR DETERMINING
THE VALUE OF VEGETABLE AND ANIMAL
OILS.*

By J. J. COLEMAN, F.C.S.,
Associate of the Institute of Engineers, Scotland.

(Continued from page 140).

THE relative drying properties of oils is a most important point. All oils above the value of Class IV., or rape oils, mentioned in the preliminary remarks, are considered commercially as non-drying oils; but there is much reason to believe that the transition from drying to non-drying oils is not so clearly marked when accurate examination is made. The order in which the drying properties gradually develop themselves is as follows:—Animal oleins, olives, rapeseeds, ground nut, Lisbon-seed, sunflower, cotton-seed and other fancy seed oils, and, finally, linseed oils.

This excludes the fish oils, which constitute a class to themselves, and which are generally supposed to be non-drying.

Under the name of fancy seed oils are included a number of oils we know little about, and which have, generally speaking, more drying properties than rape oil, and less than linseed oil.

Cotton-seed oil is the chief representative of this class of oils, and they seldom reach the consumer under their proper names, but are used, on the one hand to adulterate the so-called non-drying oils, olive and rape, so making them clog or gum, which interferes with their use for lubricating machinery or burning in lamps; and, on the other hand, for adulterating linseed oil, which they injure also in another direction, by spoiling its drying properties for paints and varnishes.

How far the drying properties of oils is to be measured by their relative powers of absorbing oxygen is an interesting chemical question, and the writer regrets that he has not had sufficient time to make a systematic course of experiments upon the subject, which perhaps he, or his friend Mr. Gellatly (who entertains the same views on this subject), may be able to accomplish at some future time, either by actually weighing the oxygen absorbed under similar circumstances by pure specimens exposed to, say, a temperature of 200° F. in thin layers, or by the use of some oxidising agent.

As to the practical methods of judging of the more or less drying properties of oils, we have:—

- (1). The nitrate of mercury test, which indicates by the consistency of the mass subjected to the reaction. Resin oil, mineral oil, and the drying oils proper refusing to solidify.
- (2). The method of comparing a sample under examination in a shallow capsule to 200° F., with a similar quantity of oil known to be pure.
- (3). The imbuing thick white blotting-paper with the oil under examination, and comparing with a similar experiment with oil known to be pure at, say, a temperature of 150° or 200° for some hours, or at ordinary temperatures for some days.

* Communicated to the Chemical Section of the Philosophical Society of Glasgow.

We now come to the question of specific gravity. The taking of the specific gravity of an oil is one of the very first of the ideas which will occur to a chemist as a means of identification, and accordingly we find accurate experiments have been made in this direction with most of the animal or vegetable oils, and by a great number of persons, so that most chemical or technological books contain clear and valuable information on the point.

An accurate determination of the specific gravity of an oil is of consequence, and the very slipshod manner in which oil-merchants deal with the matter may be remarked. They generally employ an instrument, called an oleometer, marked with some arbitrary degrees—certain figures, standing for particular oils, marked on the stem. The defect of this instrument is its long range. From the limited length of the stem, small differences in specific gravity escape notice. The oleometer used for testing oils should be marked with the ordinary specific gravity degrees, water being 1000, and the space allowed on the stem for each degree should not be less than $\frac{1}{10}$ th of an inch. This may necessitate the employment of two or three glasses for specific gravities ranging between 0.880 and the heaviest of oils. Too long a stem is inconvenient, especially when we have only small samples of oil to be tested.

Our oil-merchants are also apt to be careless about the temperature at which the gravity requires to be taken, viz., 60° F. As a rough rule for temperatures near to 60°, it is sufficiently accurate to subtract 1° of gravity for every $2\frac{1}{2}$ per cent excess of temperature above 60° F., and add similarly for temperatures below 60° F. The fatty oils, however, do not all expand equally, so that it has been proposed to compare gravities at some high point, say 212° F., as a means of detecting adulterations. This suggestion may be valuable as an adjunct to other methods. The rule of $2\frac{1}{2}$ ° F. is, however, sufficiently accurate for all normal atmospheric variations.

Having now discussed the methods which have been suggested as means of detecting adulterations, it remains for us to deal with their application to individual cases. As an indispensable preliminary to any investigation of this sort, the absence of mineral and resin oils must first be proved.

The presence of mineral oil in a mixed oil submitted to examination must not be considered as an adulteration if the oil is sold as a prepared spindle, engine, or machinery oil. In such a case, the mineral oil is probably a valuable constituent of the oil, and is added for the purpose of reducing the tendency to gumming common to most fatty oils, or else with the direct purpose of reducing the viscosity of the oil, so as to enable it to work freely upon certain classes of machinery. This prepared or mixed oil trade is legitimate. When, however, the oil is sold or offered, for instance, as a pure animal or vegetable oil, and contains mineral oil, then it becomes a case of adulteration.

Whether the presence of mineral oil be legitimate or not in the sample under examination, if it does exist there are great difficulties, for unfortunately, when mineral oil is once mixed with a fatty oil, we have no easy method of separating them without actual destruction of the fatty oils, and its presence prevents the identification of particular fatty oils.

Saponification naturally suggests itself, but practically the process is not efficient, for mineral oil unites with the soap produced, whether mechanically or chemically does not seem quite clear; at any rate, mineral oil forms an emulsion with soap solutions, which frequently show no signs of separation after standing for weeks or months.

Perhaps the formation of a lime or other earthy soap, and its reduction to powder, and the subsequent extraction of the hydrocarbons by some volatile solvent, might afford some result; but the most satisfactory method would probably be an *ultimate* chemical analysis, as the presence of mineral or resin oil hydrocarbons must wonderfully alter the relative proportions of carbon, hydrogen, and oxygen of a fatty oil.

In practice, however, mineral oil can be easily detected by two characteristic tests—

- (1). The fluorescent properties it imparts to all animal or vegetable oils.
- (2). The strongly marked aromatic burning flavour it communicates to mixtures containing it.

The first-mentioned property is brought out by smearing a metallic surface, such as tin-plate or steel, with the oil, and then viewing it at different angles in the open air or sunlight. So characteristic is this that most mechanics who use oil can detect mineral oil at once, even when present in very small quantities.

If, however, a chemist gets a dark-coloured oil to examine—for instance, a dark gallipoli or brown rape—it may be necessary to refine the sample by successive treatments with concentrated sulphuric acid and weak soda solution or lime-water (in the way oils are usually refined). Mineral oil can then be detected in the sample (which can be cleared by filtering through cotton-wool) by a pale azure-blue ring, about 1-16th of an inch deep, at the junction of the surface of the oil with the sides of the glass jar—the jar being held on a level with the eye, and the line of vision being at right angles to the beam of light. On looking from below upwards through the oil, the under portion of the surface of the oil exhibits a beautiful pale azure-blue sheen. It is easy to detect as small a quantity as $2\frac{1}{2}$ per cent in fatty oils by this method, combined with the tasting of the oil.

The absence of resin oil must also be proved. The action of a small quantity of nitric acid is said to be a good test, the colour developed being much greater than is produced with animal or vegetable oils of any class whatever. This I have, however, only had pointed out to me just before reading this paper, and have not verified it. The presence of 10 per cent of either resin or mineral oil in samples of non-drying oils subjected to the nitrate of mercury test delays their solidification very considerably. The smell of resin oil is also frequently very perceptible.

The importance of being sure of the absence of mineral or resin oil before proceeding to test specific gravities cannot be too much insisted upon, because mineral oil, ranging in specific gravity between 880 and 900, and resin oil, being nearly 1000 adjustments in specific gravity resembling those of the natural oils, can be easily effected so as to completely upset all our subsequent classifications dependent upon specific gravity.

(To be continued.)

ON THE VOLUMETRIC DETERMINATION OF CHLORINE WITH STANDARD SILVER SOLUTION OF POTASSIC CHROMATE.

By Prof. ALBERT R. LEEDS.

A CERTAIN small discrepancy is to be found in books with regard to the amount of potassic chromate to be employed in the volumetric determination of chlorine. According to one authority, four or five drops of a cold saturated solution of yellow potassic chromate is to be added to the solution under examination; according to a second, two or three drops; to a third, a small quantity; to a fourth, a certain number of tenths of a cubic centimetre of the standard silver solution should be deducted as the excess needed to produce a visible quantity of silver chromate. If the potassic chromate, which is sold by the manufacturers of pure chemicals, and which is usually pure enough for most purposes, were absolutely so, this discrepancy would cause no difference in the results. But as it is more or less contaminated with chlorides, it is essential in order to insure entire uniformity, to determine the number of tenths of a cubic centimetre of the silver solution, which correspond to the number of drops which are used of the particular potassic chromate solu-

tion. For example, the solution of potassic chromate contains 0.1 grm. of the salt to 1 c.c. water. 1 c.c. of this solution added to 70 c.c. of carefully distilled water, requires in a particular experiment, 0.25 c.c. of a standard silver solution, of which 1 c.c. corresponds to 0.1 mgrm. chlorine. Three drops of the chromate, as delivered from a 1 c.c. pipette, amount to 0.15 c.c. of the potassic chromate, corresponding to 0.037 c.c. of the silver solution. To 70 c.c. of an unknown solution containing chlorine, 0.15 c.c. of the chromate are added. In a number of trials the same number of c.c. of silver solution are required in each case, viz., 2.8 c.c. Subtracting 0.037 c.c. leaves, for the true number, 2.76 c.c.—*American Chemist.*

ESTIMATION OF MANGANESE IN SPIEGEL EISEN.

By ARTHUR WILLIS, F.C.S.,
Chemist to the Landore-Siemens Steel Company (Limited).

HAVING had considerable experience in the estimation of manganese in spiegeleisen, steel, and pig-iron, I venture to suggest the following modifications of the method given in the CHEMICAL NEWS, vol. xxix., p. 110:—

If, after evaporating in dilute hydrochloric (for steel and pig-iron) or dilute nitric (for spiegeleisen), and re-dissolving in aqua regia, the solution be transferred to a flask (instead of a beaker), and the solution neutralised in the cold, the following difficulties are overcome:—

(a). The liability to froth over.

(β). The necessity of stirring in order to prevent the vessel from cracking. This continued stirring would be totally impossible if one had six or eight experiments proceeding simultaneously.

The precipitate of basic acetate of iron will always require rather more washing than your correspondent advises, as he will find if he take the trouble to re-dissolve his precipitate, and repeat the whole operation; in fact, it is very seldom that a little manganese is not left, even after very copious washing. In all accurate determinations, therefore, the precipitate should be dissolved up, and the process repeated.

If a rather larger quantity of bromine and ammonia than your correspondent advises be added to the filtrates (from the first and second precipitation of the iron, mixed in one flask), there will be no necessity to set aside for eighteen hours. In order to throw all the manganese out of solution, it may be boiled at once, and filtered. The whole operation takes but four hours, including a resolution of the acetate of iron, and with proper appliances a dozen may be done in nearly the same time.

ON THE METHODS OF ANALYSING WATER.*

By FERD. TIEMANN.

(Concluded from page 129).

III. Methods which Determine the Amount of Nitric Acid by Measurement of the Nitric Oxide Evolved.

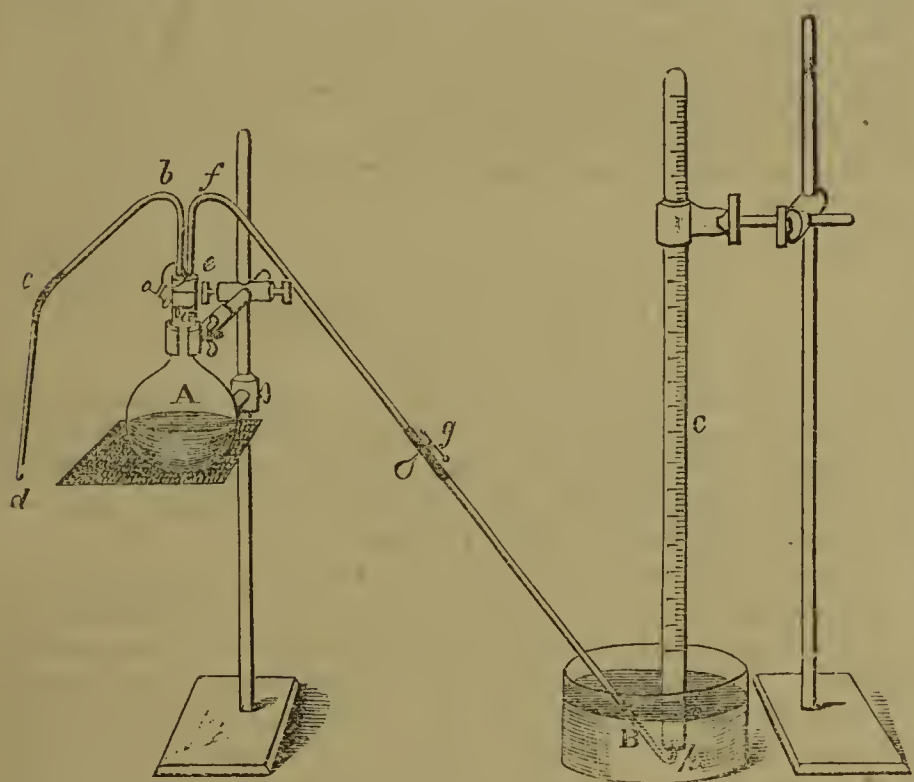
1. This principle was first applied by Walter Crum. His method, and the modification devised by Frankland and Armstrong, depend on the decomposition of the nitrates in a very concentrated solution by an excess of concentrated sulphuric acid, and on the conversion of the nitric acid set free into nitric oxide by agitation with metallic mercury. The gas is either measured in the generating-tube or, according to Frankland, is transferred to a gasometrical apparatus. Compounds of chlorine must not be present, and must be removed by a preliminary admixture of the concentrated water with a solution of the sulphate of silver. The decomposition of the nitrates,

* Abstract of a Paper from *Ber. d. Deut. Chem. Ges. zu Berlin*.

when small in amount, is a tedious process; the concentration of a large bulk of water down to 1 or 2 c.c., the transfer of the latter to the decomposition-tube, the precipitation of the chlorine by means of sulphate of silver, and the accompanying filtration are unpleasant operations.

2. Schulze modified this method by decomposing the nitrates in the concentrated water with hydrochloric acid and protochloride of iron, receives the nitric oxide liberated by the application of heat over moist mercury, and introduces it finally into a graduated tube, in which it is measured. The results are accurate, and the presence of organic substances does not interfere.

The author has modified this method as follows:—100 to 300 c.c. of the water are evaporated down to 50 c.c., and these, together with the alkaline earthy carbonates separated out by boiling, are placed in a flask, A, containing about 150 c.c. If portions of the precipitate adhere to the evaporating-basin, they are repeatedly washed with distilled water, but it is not necessary to bring them entirely into the flask, A. This is provided with an india-rubber stopper having two apertures, through which pass



two bent tubes, *a b c* and *e f g h*. The former is drawn out at *a* to a point not too fine; it passes through the stopper for the depth of about 2 centimetres. The other tube ends exactly at the under-side of the stopper. Each of them is connected at *c* and *g*, by means of india-rubber tubes, with the glass tubes *c d* and *g h*, and provided with pinchcocks at these connections. Over the lower end of *g h* a piece of india-rubber tube is drawn, to protect it from breaking. B is a glass trough filled with soda-lye at 10 per cent. C is a measuring-tube, narrow, filled with well-boiled soda-lye, and graduated into $\frac{1}{10}$ c.c.

The concentrated water is boiled for some time in A, both tubes being open. Towards the end of the operation, the lower end of *e f g h* is placed in the soda-lye, and the vapours of water are allowed to escape through it. After some minutes, the india-rubber tube at *g* is compressed with the fingers; if the air has been completely expelled from the apparatus, the soda-lye rushes up from B as if into a vacuum, and a slight shock is felt in the fingers. In this case, the pinchcock is put on at *g*, and the vapours are allowed to escape by *a b c d* until only about 10 c.c. of liquid remain in the flask. Then the flame is withdrawn, a pinchcock is fixed at *c*, and the tube *c d* is filled with water. If a bubble of air remain in the india-rubber tube at *c*, it must be removed by pressure with the fingers. The tube *c* is now fixed over the lower end of *e f g h*, which should project up slightly into *c*. We wait then a few minutes till, as the flask cools, a vacuum in the interior of the flask is manifested by the collapse of the india-rubber tubes at *c* and *g*. Solution of protochloride of iron, nearly saturated, is poured into a small beaker

marked at 20 c.c., and two other glasses, filled with concentrated hydrochloric acid, are placed in readiness. The tube *c d* is then placed in the iron solution, the pinchcock at *c* opened, and 15 to 20 c.c. of the solution allowed to flow in. The latter is cleared out of the tube by twice allowing small quantities of hydrochloric acid to enter. Gentle heat is now applied to the flask, A, by means of a Bunsen burner, till the india-rubber tubes begin to swell at *c* and *g*. The pinchcock at *g* is now replaced by the fingers, and, as soon as the pressure grows stronger, the nitric oxide is allowed to pass over into *c*. Towards the end of the operation, we increase the heat, and distil as long as the volume of gas in the tube increases. All hydrochloric acid gas is eagerly absorbed by the soda-lye. After complete expulsion of the nitric oxide, the tube *g h* is removed from the graduated tube, *c*, and the latter is placed in a large cylinder filled with cold water (15° to 18° C.). After the lapse of twenty minutes, the volume of nitric acid can be read off. It is reduced to the temperature of 0° and the barometric pressure of 760 m.m., and the corresponding quantity of nitric acid is found by calculation. The space taken up by the nitric oxide, answering to 1 milligram. nitric acid (N_2O_5) at the temperature and pressure just mentioned, is 0.41 c.c. The amounts of chloride of iron and of hydrochloric acid used should not be too large.

IV. Methods depending on the Oxidising Action of Nitric Acid upon a Solution of Indigo.

1. Marx mixes 50 c.c. of the sample with 100 c.c. pure sulphuric acid, and adds a dilute solution of indigo till the liquid takes a green colour. The value of the indigo solution is ascertained by a previous experiment with a solution of nitre of known strength.

2. Trommsdorf takes 25 c.c. of the water and 50 of the acid, finds approximately the amount of indigo solution by a preliminary experiment, and in the final assay is thus enabled to manipulate more rapidly, and escape an error which arises from prolonged action.

Goppelsröder proceeds in the preliminary trial like Marx, adds in the final assay nearly the quantity of indigo required before the sulphuric acid, and then a further amount of indigo until the green colour appears. An equal quantity of acid by this means decolourises a greater amount of indigo.

Van Bemmelen mixes the water first with the indigo solution, adds $1\frac{1}{2}$ to 2 volumes of sulphuric acid, and finds by repeated trials the exact amount of extra indigo solution needful to give the green shade.

Finkener mixes 50 c.c. of water with 33 of acid, heats the whole to 122° to 125° C., and titrates with the indigo liquor.

Fisher allows the water to flow into a mixture of indigo liquor and sulphuric acid.

In all these processes, the presence and amount of chlorides has a modifying effect. The presence or absence of organic matter, the temperature, and the duration of the operation are also influential.

Of these methods, the author prefers Trommsdorf's; he uses an indigo-liquor of which 6 to 8 c.c. = 1 milligram. N_2O_5 , and takes for the trial quantities of water containing not more than 3 to 4 milligrams. nitric acid in 25 c.c. If the water is richer in nitrates, it is diluted with known quantities of distilled water free from nitrates. The author, summing up, pronounces the method of Schulze and those of Reichard and Trommsdorf the most generally applicable. That of Schulze, as modified by the author, gives under all circumstances the most accurate results.

Popular Chemistry.—We extract the following from the *Family Herald*, March 21, 1874:—"To detect nitric acid in wines, it is necessary to saturate the wine with baryta, and then distil; phosphoric acid is added to the residue and re-distilled, when the acetic acid will be found in the distillate."

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Anniversary Meeting, March 30th, 1874.

Dr. ODLING, F.R.S., President, in the Chair.

THE PRESIDENT said that the duty devolved upon him to lay before the Fellows of the Society an account of the changes which had taken place since their last Anniversary Meeting. At that time there were 688 Members, 70 had since been elected, and they had lost 19 by death and retirement; so that at present there were 739 Fellows, being an addition of 51 to their numbers. They had also lost one of the Foreign Members, of whom there were now 31. (The President then read short biographical notices of the following members who had died during the past year:—Baldwin Francis Duppa, Frederic Crace Calvert, Henry Bence Jones, William Husskisson, jun., Charles Davy, William John Hay, and Daniel Stone.) The Foreign Member whom we had lost was Justus Liebig, the worker who, by his discoveries in organic chemistry, and through the pupils he had educated in that department of science, had mainly contributed to raise German chemistry to the place it now occupies. It was proposed that early next session Dr. Hofmann should deliver the third Faraday lecture, being a "Discussion of the Early Work of Liebig." It was the pleasant duty of the late president to congratulate the Fellows of the Society on the increase of the number of papers—from twenty-two in 1872 to fifty-eight in 1873. During the past year the number had been 51, in addition to the four lectures. Dr. Odling called attention to the fact, which did not appear to be very generally known, that the Society made small grants to assist experimental chemists in the prosecution of original research, and that the Royal Society has the means of making larger grants for the same object. There are also in Oxford and Cambridge many scholarships of the value of from £200 to £300 a year each for the encouragement of chemical science, besides a number of Fellowships of about the same value devoted to the same object. He could not allow the occasion to pass without congratulating the Fellows on their taking possession of their new apartments. The meeting-room was not quite so satisfactory as might be wished, but the Council hoped to remedy its defects as far as possible. The preparation-room, although as yet unfurnished, would doubtless be of the greatest value at a future time in illustrating the papers read before the Society, for chemistry was essentially a science of phenomena which could be observed. The President then discussed the pecuniary affairs of the Society, which are very satisfactory, notwithstanding the heavy expenses necessarily incurred in removing into the new rooms; at the same time, it must be remembered that these will entail a considerably increased annual expenditure. He also noticed the various improvements, and the proposed extension of the library by the completion, where possible, of the various sets of serials, and the purchase of standard works. Attention was also called to the "Complete Index of the Journal of the Chemical Society," from its commencement, which valuable work has just been finished by the Editor, Mr. Henry Watts.

The TREASURER having given his report of the financial state of the Society, the PRESIDENT read the bye-law relating to the election of Officers, which was then proceeded with, Messrs. Neison and Wills acting as scrutators.

The following is the list of Officers and other Members of Council elected for the ensuing year:—

President.—W. Odling, M.B., F.R.S.

Vice-Presidents who have filled the office of President.—Sir B. C. Brodie, F.R.S.; Warren De la Rue, Ph.D., F.R.S.; E. Frankland, D.C.L., F.R.S.; A. W. Hofmann,

D.C.L., F.R.S.; Lyon Playfair, Ph.D., C.B., F.R.S. A. W. Williamson, Ph.D., F.R.S.; Col. P. Yorke, F.R.S.

Vice-Presidents.—J. H. Gladstone, Ph.D., F.R.S.; A. Vernon Harcourt, M.A., F.R.S.; G. D. Longstaff, M.D.; H. E. Roscoe, Ph.D., F.R.S.; Maxwell Simpson, Ph.D., F.R.S.; A. Voelcker, Ph.D., F.R.S.

Secretaries.—W. H. Perkin, F.R.S.; W. J. Russell, Ph.D., F.R.S.

Foreign Secretary.—H. Müller, Ph.D., F.R.S.

Treasurer.—F. A. Abel, F.R.S.

Other Members of Council.—J. Attfield, Ph.D.; H. E. Armstrong, Ph.D.; Dugald Campbell; J. Dewar, F.R.S.E.; A. Dupré, Ph.D.; G. C. Foster, F.R.S.; M. Foster, M.D., F.R.S.; Peter Spence; Hermann Sprengel, Ph.D.; Thomas Stevenson, M.D.; R. Warrington; C. R. A. Wright, D.Sc.

Dr. WARREN DE LA RUE then proposed a vote of thanks to the President, which was seconded by Mr. W. THORP. The Officers and Council were proposed by Dr. STEVENSON, seconded by Mr. A. TRIBE, Dr. RUSSELL, the junior Secretary, thanking the Fellows in their name. A vote of thanks to the Auditors was then proposed by Professor ABEL, and seconded by Mr. C. E. GROVES; and one to the Editor of the Journal and the Abstractors by Dr. HUGO MULLER, seconded by Dr. WARREN DE LA RUE, to which Mr. HENRY WATTS responded.

The meeting was then adjourned until Thursday, April 2nd.

NOTICES OF BOOKS.

The Laboratory Guide, a Manual of Practical Chemistry, specially arranged for Agricultural Students. By A. H. CHURCH, Professor of Chemistry in the Agricultural College, Cirencester. Third edition, enlarged and revised. London: J. Van Voorst.

THIS useful manual of analytical chemistry as applied to agriculture is already favourably known. The present edition has been enlarged by the addition of some fifty pages. Certain portions have, further, been re-arranged, as will be seen on comparing the tables of contents in the present and in the former edition. The general methods laid down for the analysis of bone-ashes, superphosphates, coprolites, &c., are unaltered. The "fusion method" is recommended for the determination of phosphoric acid in Sombrero and Redonda guanos, as well as in certain nitrogenous guanos, such as those of Guanape, Ballestas, &c. In speaking of "reduced" phosphates, the author disputes the theory that they are equal in value to those which remain soluble. Even though all soluble phosphates do ultimately become reduced in the soil, yet, by being at first presented in a soluble state, they possess an "initial diffusive power" which reduced phosphates lack. The former consequently are distributed through the soil more equally, and the chances are greater that every rootlet of the crop will be able to find a particle of phosphate of lime in immediate contact with its pores.

This reasoning is perfectly correct, and agrees with what we have repeatedly heard advanced by experienced and judicious agriculturists and manure-makers.

In estimating the "soluble phosphate" in superphosphates, the student is very properly cautioned against extracting with hot water. In fact, lixiviation with small successive portions of cold water is preferable to treatment at once with a larger volume.

The uranium methods, gravimetric and volumetric, of determining phosphates are described in detail.

We were somewhat surprised at the statement that blue vitriol is "often fraudulently employed by bakers." As far as we have been able to ascertain this fraud is decidedly rare in England.

To students of agricultural chemistry, and to all interested in the knowledge of soils and manures, this "Laboratory Guide" may be safely recommended.

Chimie Inorganique Élémentaire. Par EDOUARD GRIMAU, Professor Agrégé à la Faculté de Médecine de Paris. Paris: Germer Baillière.

THIS work consists of a series of lectures delivered at the Faculty of Medicine. Its speciality lies in the fact that, after a brief explanation of what is meant by simple and compound bodies, and what is the nature of chemical action, the author proceeds at once to the consideration of the individual elements and of their compounds, explaining all theoretical points as they successively arise. M. Grimaux is one of those chemists who consider tin not to be a metal. If we reflect that it was one of the six bodies a survey of whose properties gave rise to the idea of a metal, its exclusion from that class seems to us no less paradoxical than would be the banishment of sodium chloride from the class of salts, olive oil from that of oils, or spirit of wine from the alcohols. It is perfectly true that the higher oxide of tin is capable of playing the part of an acid. But so are the oxides of not a few other bodies whose place among the metals is hitherto undisputed.

Peroxide of tin, further, is capable of acting as a mordant along with colouring matters of a feebly acid character, as well as of combining with powerful acids. Its claims to the nature of an acid are, therefore, no stronger than those of alumina, and far inferior to those of the chromic and manganic acids.

Is it not time for the old binary classification of metals and non-metals—or metalloids, as the French most unhappily call the latter—to be thrown aside?

The descriptions are clear and full, and the illustrations are numerous, but not a few of the elements are altogether omitted. This strikes us as a mistake. The work is written from a medical point of view, and is mainly addressed to medical students. Now, a body too rare to be of technological importance may still, as a poison or a remedy, merit the attention of the physician. Chemically speaking, the omission of any known element is unjustifiable.

The work concludes with a brief outline of qualitative mineral analysis. The value of the index is impaired by a considerable number of typographical errors.

CORRESPONDENCE.

ON AN ALLEGED REDUCTION OF CARBONIC ACID TO CARBONIC OXIDE.

To the Editor of the *Chemical News*.

SIR,—Some time ago a notice from E. N. Horsford went through various chemical journals, stating that carbonic acid would be reduced to carbonic oxide by exposing it, with protophosphate of iron, to the sunlight, and that this process would be very important in the process of vegetable life. Although I had considerable doubt about the truth of this statement, I repeated the experiment exactly as stated by Horsford. After three weeks' exposure to the sun the gas was tested, and found to be plain carbonic acid; not the *slightest trace* of carbonic oxide could be detected. As a general thing I found no iron salt capable of having any reducing influence upon carbonic acid.—I am, &c.,

E. SHEPHERD.

Baltimore, March 10th, 1874.

MISCELLANEOUS.

The Jubilee Volume of "Poggendorff's *Annalen der Physik und Chemie*."—We have great pleasure in calling the attention of our readers to the special volume of the *Annalen*, about to be issued. For fifty years this valuable journal has been edited by J. C. Poggendorff. In commemoration of so unprecedented an occurrence, the friends

and admirers of the editor have combined to produce a "jubilee volume," distinguished alike by the character of its contents and by the elegance of its appearance. When we call to mind the eminent merit of Dr. Poggendorff and the European reputation of the *Annalen*—associated as they have been for half a century with the foremost names in physical and chemical research,—we can do no other than express our cordial approbation of the undertaking and our best wishes for its success. England ought not to fall behind any country in the number of subscribers to this commemorative volume. We are deeply indebted to Dr. Poggendorff, and it is but just that we should do him honour.

Expansion by Heat.—In prosecuting experiments to ascertain the expansion of various substances by heat, the following experiment was tried:—The bulb of a thermometer was suddenly plunged into melted lead. The mercury instantly darted down far below zero. The action was so quick that the point could not be ascertained. This was caused by the sudden expansion of the bulb by heat before it reached the mercury by conduction; this then began to rise very rapidly, and before it had arrived at the top of the tube the bulb was withdrawn. The experiment requires adroitness, for, as we all know, the instant that the mercury touches the top, the bulb will burst. This must be greased before immersion in the fused lead, otherwise a film of the metal will adhere and retain sufficient heat to carry the mercury to the top with a consequent fracture. A thermometer treated in this rough manner afterwards showed an index error of six degrees, the mercury having risen to that extent; but after a few days the equilibrium was partly restored, and the error remained permanently at three degrees.—*Engineering and Mining Journal*.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, February 9, 1874.

Experimental Study in Interior Ballistics.—Gen. Morin.—The author indicates a graphic method of determining the motor forces exerted at different points in the course of a projectile through the bore of a gun for powder and for gun-cotton. He also gives a representation of the law of variation of the motor forces, or interior pressures, in function of the lengths of the bore traversed, and examines the curves obtained from different explosive substances.

New Clinical and Experimental Researches on the Movements and Rest of the Heart, and the Mechanism of the Course of Blood through its Cavities in the Normal State.—M. Bouilladn.—The author points out the resemblance between the action of the heart and that of a suction- and forcing-pump, as regards both structure and function. The hearts of various animals were laid bare, and observed with eye and hand. One curious result obtained was that (contrary to what is taught) the revolutions of the heart do not commence with the same movements in animals having only one ventricle and those having two. In the latter (of which man is an example) they begin with ventricular systole and auricular diastole. In univentricular animals (such as frogs and tortoises) they begin with ventricular diastole and auricular systole. M. Bouilladn also points out that, like the arteries, the heart is a four-timed instrument, having two movements and two times of rest. If we give the name of *pulse* to its beats, as we do to those of the arteries, the pulse of the heart in the normal state is *dicrotous*, like that of the arteries, and not *monocrotous* as has hitherto been taught.

Observations at the Observatory of Toulouse.—M. Tisserand.—A table of the eclipses of Jupiter's satellites during 1874.

Observations of Aurora Borealis on February 4, 1874, at Toulouse.—M. Tisserand.

Memoir on the Problem of Three Bodies.—M. Mathieu.

Resistance of Glass Tubes to Rupture.—M. Cailletet.—The author has been led to study the subject in his researches on the compressibility of gases. His conclusions are—(1) That a glass vessel is broken much more easily by an interior pressure than by an exterior. Thus, a vessel of glass 0.55 m.m. thick, and 17 m.m. diameter, was crushed under a pressure of 77 atmospheres; whereas an interior pressure of 38 atmospheres was sufficient to burst it. (The pressures were produced through liquids.) (2) That the quantities by which the volume of the vessel varies are proportional to the pressure, at least within wide limits, especially where this pressure is exerted on the exterior. Thus, in one case, the rise of liquid in a capillary tube forming part of a vessel of glass (1.05 m.m. thick, 9.05 m.m. internal diameter) subjected to exterior pressure was 6 m.m. per 20 atmospheres, and the experiment was continued up to 460 atmospheres, the rise throughout being proportional to the pressure. M. Cailletet has succeeded in constructing a very sensitive manometer based on these properties of glass.

Employment of a Birefringent Prism for Determination of the Axes of Ellipses.—M. Janettaz.

New Supernumerary Bands Produced in Solutions of Chlorophyll under the Influence of Sulphuretted Agents.—M. Chautard.—If chlorophyll be dissolved in sulphide of carbon, or an alcohol solution be made of chlorophyll from certain Cruciferae (cabbage, *e.g.*) with a little ammonia added, and the solution be kept a few months in the dark, there appears, in the part of the spectrum more refrangible than the red, a very fine pale band in addition to the *specific* band of the red, which remains in its place intact. This peculiarity may sometimes be of importance in the search for chlorophyll in excrementitious matters which often contain sulphuretted elements, naturally giving rise to the appearances indicated.

Principles of the Flight of Birds.—M. Bertin.—An instructive paper, hardly suitable for abstraction.

Volcanic Phenomena of Nisyros.—M. Gorceix.

Safety Electric Cable against Fires.—MM. Joly and Barbier.—Two wires, insulated from each other by gutta-percha, are corded together into a cable, and are connected at one end with a battery and electric bell. When fire breaks out in any part of the building through which the cable passes the gutta-percha is freed and the wires come into contact, thus closing the circuit and ringing the bell. The condition of the apparatus is tested by means of a peg commutator at the other end of the cable.

Measurement of Heat.—M. West. (Extract.)—The author investigates the relations between calorimetry and thermometry. He made use of the best data of science to calculate the exterior mechanical effect of a caloric applied to raise, from zero to 1° C., first nitrogen, then hydrogen, and he got for these two kilogrammetric quantities closely agreeing. This being the case, notwithstanding the inequality of distance of these gases from their point of liquefaction and general difference of physical properties, it follows that whenever a caloric is applied to one of the gases considered perfect, and at unequal distances from the liquefying point, it produces the dilatation at zero, and, conversely, when a scale of temperature is graduated by the aid of volumes which are in constant relation to one another, this scale will indicate, for each division, the same number of calories. The author has calculated a manual of correspondence for passing from the ordinary scale of temperatures to a proposed scale, this manual being extracted from a comparative table of two series of volumes of hydrogen gas.

M. Croce Spinelli announced his intention of making a balloon ascent, in which he would take with him a supply of oxygen for breathing in the rare upper regions.

The Winter of 1874.—M. de Tastes.—The author holds the theory that there is a large air-current, an aerial river, accompanying the Gulf Stream, passing over Northern Europe, then going south over the east of Europe (becoming more and more dry during its progress) and entering tropical Africa, and probably uniting with the north-east trade-winds on the east coast, while the equatorial current is a returning branch. Vortical movements arise from friction of the current with the comparatively calm mass of air forming (in our hemisphere) the left bank of the river, where these movements are opposite to that of the hands of a watch. The river has its floods and its abatements; during the former the whirlwinds are more frequent and intense. The aerial circuit circumscribes a mass of air having higher atmospheric pressure than the body of the current, and which is to the current what the *Sargasso* sea is to the Gulf Stream. In this *zone of calms* the air has only irregular movements from causes purely local, or eddies in its circumference. Its extent varies with the amplitude and force of impulsion of the surrounding river, sometimes being compressed within the limits of Central Europe, when the isobaric maps show a series of irregular concentric circles, the gradient decreasing from the centre to the circumference, about a true centre of compression. The character of our winters is, in great measure, determined by the situation and extent of this zone of calms. If it rests on the Mediterranean and the north of Africa (the most ordinary case) the bed of the equatorial current extends over the British Isles and the north-west of France, and we have mild and rainy winters. If the zone of calms is carried further to the south the current bends eastwards towards Spain and the Mediterranean. France is then on the left bank, and the cold air of northern latitudes comes to it. It is then we have the intense winters, which, fortunately, occur only twice or thrice in a century. Lastly, the equatorial may have such a force of impulsion that it approaches Europe by the north of Norway and Lapland, letting the zone of calms cover Central Europe. Cold weather may then occur in our latitudes, but it is due to excess of nocturnal cooling over the weak insolation of our short days. We are then on the right bank of the current, separated from polar colds by its whole breadth. The winter is moderately cold, the rains are rare, fogs abundant, winds weak, and our watercourses fall. This is precisely the character of the present winter.

Chemical Characters of the Uredo of Maize, and on Certain Questions of Vegetable Analysis.—M. Hartsen.—Under the influence of this parasite the grain is transformed into an oval bladder filled with a brown or reddish powder. The colouring matter is not extracted by absolute alcohol, ether, benzol, petroleine, chloroform, acetic acid, caustic potash, &c. It is perfectly inodorous even at 100° C., but if boiled in water it gives off a disagreeable and bituminous odour. If the vapours are condensed they form an offensive liquid, which if allowed to stand for twenty-four hours, deposits drops of a camphor-like matter of a crystalline structure. When treated with nitric acid the uredo gives off an odour of bitter almonds, whilst oxalic and suberic acids and a considerable quantity of grease are formed. Precipitated sulphuret of lead absorbs and retains many substances, such as resins, colouring matters, &c. In decolourising power it scarcely yields to animal charcoal, and, in certain cases, is even preferable. It deserves attention whenever the acetate of lead is used to isolate acids and other vegetable matters. After having decomposed the precipitate with sulphuretted hydrogen, the sulphuret of lead should not be thrown away until it has been exhausted with boiling alcohol. In the extraction of chlorophyll benzol may be used instead of ether, the leaves being previously soaked in alcohol.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin,
No. 20, January 26, 1874.

Deacon's Chlorine Process.—R. Hasenclever.—The author remarks that Weldon's process can be carried on without particular difficulty, and without any especial superintendence—points of great importance on account of the large scale of the English alkali works. On the other hand, the apparatus for Deacon's process requires care in its construction, preservation, and working. The chloride of lime produced by this process was formerly too weak, and the consumption of coal was high. Now the chloride of lime contains 35 per cent of available chlorine, and the fuel consumed amounts to half the weight of the finished product. The chlorine obtained by Deacon's process is so diluted with nitrogen and air that for perfect absorption the surfaces covered with lime is six times larger than in the ordinary chloride of lime works. The introduction of the process is rendered costly by these extensive chambers. On the other hand, the amount of labour is trifling, the consumption of fuel moderate, and manganese is entirely dispensed with. Deacon's process is well calculated to remove the hydrochloric acid nuisance from the air and the rivers.

Aromatic Phosphorus Compounds. (Third communication.)—A. Michaelis.—This paper is not adapted for abstraction.

On Carbo-Diphenylimid.—W. Weith.—This substance, $C_{13}H_{10}N_2$, consists of—

Carbon	80.41
Hydrogen	5.15
Nitrogen	14.44

100.00

It is sparingly soluble in benzol, and melts between 168° and 170° . The author has examined its behaviour with hydrochloric acid, water, aniline, and sulphuretted hydrogen.

Constitution of Anthracen.—Arno Behr and W. A. van Dorp.—A hypothetical paper.

Diallyl Derivatives.—Louis Henry.—The author investigates propargyl octobromide, and the tetrabromide of bibromated diallyl, $(C_6H_8Br_2)Br_4$.

Constitution of Parabanic Acid, and the Synthesis of its Homologues.—N. Menshutkin.—A preliminary notice.

Sulphur Compounds of Selenium.—H. von Gerichten.—An examination of the compounds SSe_2 , SeS_2 , AS_2SeS_2 , and AS_2SSe_2 . Analogous antimonial compounds are still under examination.

Neutralisation-Heat of the Oxides of Lanthanum, Cerium, Didymium, Yttrium, and Erbium.—Julius Thomsen.—The author finds that the hydrates of these oxides approach the most powerful bases as regards their heat of neutralisation.

On Methyl-hydantoinic Acid.—E. Baumann and F. Hoppe-Seyler.—The authors, taking up the incomplete researches of the late A. Schultzen, caused an aqueous solution of sarkosin to act upon cyanate of potash and an equivalent of sulphate of ammonia, and obtained methyl-hydantoinic acid—

Carbon	36.36
Hydrogen	6.06

This acid is not very readily soluble in cold water or alcohol, but readily soluble in both with the aid of heat, as also in ether, whether aqueous or alcoholic. It has a strong acid reaction and a pleasant sour flavour. Along with this acid were found undecomposed sarkosin, urea, and methyl-hydantoin. Hydantoinic acid may also be obtained by boiling a solution of glycocoll and urea with excess of baryta water till no more escape of ammonia is perceived. Sarkosin, also, if boiled with urea and baryta.

On Nitrophenol and Dinitro-Benzol.—H. Salkowski.—A note on the "relative position of the groups to be substituted" in the benzol derivatives.

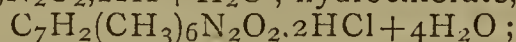
Glucino-chloride of Palladium.—A. Welkow.—This salt is composed of—

G	1.99
Pd	22.44
Cl	45.09
H ₂ O	30.48

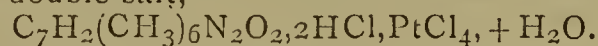
100.00

and its formula is $G.PdCl_6 + 8H_2O$. At 130° it loses all its crystalline water, and when heated further proves tolerably permanent. The corresponding platinum salt loses only the half of its crystalline water. The remainder only escapes above 150° , the compound being simultaneously decomposed.

Action of Iodide of Methyl upon Diamido-Benzic Acid.—Peter Griess.—The author has examined free hexa-methylated diamido-benzoic acid, $C_7H_2(CH_3)_6N_2O_2$; hydriodate of hexa-methylated diamido-benzoic acid, $C_7H_2(CH_3)_6N_2O_2 \cdot 2HI + H_2O$; hydrochlorate,—



carbonate, $C_7H_2(CH_3)_6N_2O_2 \cdot CH_2O_3 + 3H_2O$; and the platinum double salt,—



Synthesis of Phenanthren from Toluol.—C. Graebe.—The author, on repeating Berthelot's experiment, by the passage of toluol through a red-hot tube, obtained phenanthren in addition to the anthracen and other products mentioned by the French chemist.

Action of Heat upon Methyl Diphenylamin.—C. Graebe.—One portion of the methyl diphenylamin is converted into diphenylamin and carbazol. Another portion yields benzol, aniline, and cyanphenyl.

Diphenylen-Sulphide and Diphenylen-Disulphide.—C. Graebe.—The author considers this compound identical with the para-phenylen-sulphide of Stenhouse, and ascribes to it the formula $C_{12}H_8S$. Diphenylen-disulphide, $C_{12}H_8S_2$, he considers to be the phenylen-sulphide of Stenhouse.

Derivatives of Diphenyl.—G. Schultze.—The author has obtained and examined nitro-diphenyl, $C_{12}H_9NO_2$; amido-diphenyl, $C_{12}H_9NH_2$; bromnitro-diphenyl,—
 $C_{12}H_8BrNO_2$;
and iso-amido-nitro-diphenyl, $C_{12}H_8NO_2NH_2$.

Derivatives of Paranitro-toluol-sulphuric Acid.—Fr. Jansen.—The author has formed and examined a number of derivatives of this acid.

Constitution of the Benzol Bodies.—Th. Petersen.—A continuation of the author's hypothetical studies on this subject.

On Eucalyptol.—A. Faust and J. Homeyer.—The authors find the eucalyptol of Cloëz to be a mixture of a terpen and cymol.

Decomposition of Dichlorallylen into Acrylic Acid.—A. Pinner.—The contents of this brief paper are sufficiently plain from the title.

Chlorhydrins, or Basic Chlorides of the Polyatomic Radicals.—Louis Henry.—A critique on a paper on the same subject (*Berichte*, bd. vi., p. 1023) with reference to earlier demonstrations of the alcoholic nature of the chlorhydrins.

Specific Gravity and Volume of Iodic Acid, and the Solutions of Periodic Acid.—Julius Thomsen.—A physical paper. The author finds that a contraction takes place when solutions of iodic acid are mixed with water. With periodic acid this is not the case.

Preparation of Peroxide of Hydrogen.—Julius Thomsen.—Peroxide of barium in fine powder is added to dilute hydrochloric acid almost to saturation. To the solution, cooled and filtered, baryta water is added till the silica and the extraneous oxides have been thrown down, and a faint precipitate of hydrated peroxide of barium is formed. The liquid is then filtered, and baryta water added in quantity, when crystalline hydrated per-

oxide of barium is thrown down. The precipitate is filtered, and washed till the washings are free from hydrochloric acid, and is preserved in the moist state in closed vessels. To prepare peroxide of hydrogen this moist hydrate is added to dilute sulphuric acid with constant stirring. This is continued till only a trace of free acid remains. The sulphate is then allowed to subside, and the liquid is filtered. The filtrate is freed from traces of sulphuric acid by the cautious addition of dilute baryta water.

On Glucino-Platino-Chloride.—Julius Thomsen.—The author points out that he anticipated Welkow in describing this salt.

Influence of Temperature on the Development of Heat during Chemical Reactions.—Alex. Naumann.—A question of priority.

Dissimilar Behaviour of Isomeric Nitramines under the Action of Alkalies.—P. Wagner.—This paper is not adapted for abstraction.

On Cœrulignon.—A. W. Hofmann.—The analysis of a crystalline specimen showed $C_{16}H_{16}O_4$. Further investigations are announced.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

An improved process for smelting zinc, and apparatus therefor. John Imray, 20, Southampton Buildings, Chancery Lane, Middlesex. (A communication from Oscar Loiseau, engineer, Ougrée, Liège, Belgium). May 5, 1873.—No. 1623. This invention relates to a process and apparatus for smelting zinc oxide ore. The ore, mixed with carbonaceous powder, is placed in a heated oven situated over a furnace charged with coke or other carbonaceous matter. This furnace is supplied with air preferably heated in such limited quantity as to generate carbonic oxide, which is led hot through the oven above. The ore is thus reduced, and zinc vapour is carried by the gases through exposed passages, wherein it is condensed, and from the bottoms of which liquid zinc flows. The condensation of the zinc is aided by keeping the gases under pressure, which is effected by forcing air into the generating-furnace, and making the gases, at their final escape, pass a loaded valve. In escaping, the gases bubble through water, whereby any portions of zinc vapour are condensed, and they may then be led to a boiler or other furnace, where such [combustible*] ingredients as they may contain can be utilised as fuel. Steam may be introduced into the oven along with the reducing gas.

Improved process for bleaching jute and other textile fibres, and for preparing the same for the reception of colours, and for the manufacture of paper. John Frederick William Hodges, chemical assistant, Belfast, Ireland. May 8, 1873.—No. 1672. The yarn or cloth is first steeped into a weak solution of an alkaline carbonate for two hours, and afterwards boiled for two hours; it is then steeped for one hour in a weak solution of hydrochloric acid, and then washed. It is afterwards placed in a solution of an alkaline carbonate, then in a solution of oxychloride of magnesium, and finally steeped in weak hydrochloric acid, and then well washed and dried.

Improvements in treating sewage in order to produce manure therefrom. Eugene Moriarty, house steward, Portobello Road, Notting Hill, Middlesex. (Partly a communication from Jacques Jules Renous Céré, Brussels, Belgium). May 9, 1873.—No. 1686. Sewage is treated with plaster or sulphate of lime, tar, wood charcoal, acid phosphate of magnesia, and phosphate or sulphate of iron, ammonia, sulphur, salt-petre (nitrate of potash), phosphoric acid, and nitrate of soda.

Improvements in the purifying of crude anthracen of commerce. Charles Caspers, Newcastle-on-Tyne, Northumberland. May 9, 1873.—No. 1689. This Specification describes taking crude anthracen from which all oily matters have been separated as far as possible by mechanical means, and washing it with light oil for one or more times, and finally washing with methylated spirit. The anthracen thus purified is afterwards kept heated at about $100^{\circ}C$. to dry it thoroughly. Or after washing it with light oil the partially-purified anthracen may be dissolved by the aid of heat in a fresh quantity of light oil, and when allowed to cool is precipitated in a purer state; the sediment may be again washed with light oil and spirit, or anthracen purified as above described may be heated until it fuses, and be then allowed to cool slowly. When it is desired to still further purify the anthracen, it is sublimed in a closed retort.

Improvements in the manufacture of bleaching-powder and in apparatus employed therein. Charles Wigg, alkali manufacturer, Liverpool. May 12, 1873.—No. 1725. First. Hydrochloric acid from Messieurs Hargreaves and Robinson's direct-action-sulphate converting chambers, or hydrochloric acid from any other source, is passed with atmospheric air into a heated closed retort or chamber containing pieces of pumice-stone or refractory material. The product of the

decomposition, which is chlorine, is passed into a chamber containing lime on shelves, or through a series of chambers fitted with agitators. Second. The closed retort or chamber above mentioned is fitted with inlet pipes for hydrochloric acid and air, and an outlet pipe for chlorine. The entering air, when at pressure, may draw in the hydrochloric acid by lateral induction. Third. A series of chambers containing lime are connected by passages, and each chamber is provided with an agitator to throw up the lime and bring it into intimate contact with the chlorine and gases.

Improvements in the manufacture of metallic alloys. Alexander Parkes, Gravelly Hill, near Birmingham. May 13, 1873.—No. 1736. This Provisional Specification describes producing an alloy by mixing a manganese ore with a copper ore (or with an oxide of nickel) and carbon. These materials are exposed in a powdered state to a moderate heat in a closed retort. When the charge has been allowed to cool, the metallic globules which are found diffused through the mass are separated and melted.

Improvements in the manufacture of magnesia. Robert Stirling Newall, Washington Chemical Works, Newcastle-on-Tyne. May 13, 1873.—No. 1741. My improvement consists in submitting the magnesia, deposited in the manner described in the Specification of the Patent of Hugh Lee Pattinson, dated September 24, 1841, or other magnesia either in a dry or partially dry state, to pressure in moulds, by which process it is rendered denser and tougher, and therefore more suitable for transport than magnesia of the usual kind.

NOTES AND QUERIES.

Notes on the Utilisation of Sewage.—(From the "Report of the Main Drainage Committee for 1864," vol. 487).

4361. (To Mr. Lawes.) Professor Way states that the sewage permanently improves the land, and that the good effects of it may be seen many years afterwards; but he says that the power of the earth to extract the manurial properties from sewage-water are limited. Do you agree with him in that?—Yes.

4362. So, that if you exceed that limit, all the sewage that you use above that limit is wasted?—Yes.

4363. Would it run away into the drains?—Yes.

4364. Would you see that it was being wasted, by the water that ran through the drains being discoloured?—We have carefully analysed a great deal of drainage-water, and we find that there is a large amount of sewage in the water that runs away, and that in the water from the field that slopes the most is contained the most sewage.

4365. If you put on a small dressing, would there be less of that matter in the liquid that runs away?—Proportionably so, no doubt.

4366. (To the same.) It is matter in suspension that colours the sewage-water, is it not?—Yes, that is almost all retained in the soil.

4367. But if the water that runs away is coloured, does it not prove that it still retains some of that suspended matter?—Yes, no doubt.

4368. The chief manurial properties of sewage-water are in solution, are they not?—Yes.

4369. But if the water that runs away contains matter in suspension, it is still more certain to contain what is in solution?—No doubt.

4370. Then if you see the water in the drains is coloured, you may be sure it is carrying away a good deal of the manurial property of the sewage, and you may be sure that the limited power of the earth to extract those properties from the sewage has already been exceeded?—No doubt.

4472. (Mr. Lawes.) I cannot conceive that sewage is really adapted for producing anything but milk profitably; it is a very weak grass that it produces, containing an immense amount of water, much more than common grasses contain; but it seems to be admirably adapted for producing milk.

4641. (To Mr. Lawes.) You spoke, did you not, of the retention of the fertilising ingredients of the sewage by the constituent parts of the soil?—Yes.

4642. Did not Professor Way discover that property of the soil?—Yes.

4643. Did he not state that that was a power possessed only by clay soils and other fertile soils of that nature?—To a great extent.

4644. Did he not state in his evidence that a sandy soil had not that power?—Yes, he did.

4645. Then a sandy soil would not retain the fertilising ingredients of the soil to a great extent, but all the soluble matter would run through with the water; would that be so?—Not the whole, but a considerable amount of it would.

MEETINGS FOR THE WEEK.

TUESDAY, 7.—Civil Engineers, 8.

WEDNESDAY, 8.—Society of Arts, 8.

London Institution, 7.

FRIDAY, 10.—Astronomical, 8.

Quekett Microscopical Club, 8.

* * Vol. XXVIII. of the CHEMICAL NEWS, containing a copious index is now ready, price 11s. 4d., by post, 12s., handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 2s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxix. commenced on January 2nd, and will be complete in twenty-six numbers. READING CASES, price 1s. 6d. each, post free, may also be obtained at the Office.

* The word "combustible" is found in the copy of the Abridgment delivered by the Applicant, but does not appear in the original Abridgment.

THE CHEMICAL NEWS.

VOL. XXIX. No. 750.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

(Concluded from p. 147).

RESULTS.

TEN results of the most trustworthy weighings (with $\text{NO}_3 = 61.889$) are†:—

Determination.	True weights <i>in vacuo</i> .			Calculated atomic weight from these data.
	Weight of thallium taken.	Weight of nitrate of thallium + glass.	Weight of glass.	
	Grs.	Grs.	Grs.	Grs.
A.	497.972995	1121.851852	472.557319	203.666
B.	293.193507	1111.387014	729.082713	203.628
C.	288.562777	971.214142	594.949719	203.632
D.	324.963740	1142.569408	718.849078	203.649
†E.	183.790232	1005.366796	766.133831	203.642
F.	190.842532	997.334615	748.491271	203.636
G.	195.544324	1022.176679	767.203451	203.639
H.	201.856345	1013.480135	750.332401	203.650
I.	295.683523	1153.947672	768.403621	203.644
K.	299.203036	1159.870052	769.734201	203.638

I wish it to be noted that I have made determinations with considerable weights of thallium. In ordinary analysis, chemists are satisfied to take 5 or 10 grains of the substance under investigation: here I have gone to the very highest weight that can be entrusted, with safety, to the balance. The lowest weight of thallium taken is 183.790232 grains, the heaviest 497.972995 grains, the remaining determinations varying between these limits. It is hardly necessary to say that the purpose has been to eliminate the error arising from manipulation with small quantities, and to produce such variety in the results as to render the chances of coincidence of very small value.

Let me now tabulate the results of the determination, with the view to ascertain severally their degree of approximation to the arithmetic mean:—

A.	203.666	+0.024
B.	203.628	−0.014
C.	203.632	−0.010
D.	203.649	+0.007
E.	203.642	.000
F.	203.636	−0.006
G.	203.639	−0.003
H.	203.650	+0.008
I.	203.644	+0.002
K.	203.638	−0.004

The arithmetic mean of the ten observations is

$$\alpha = \frac{2036.424}{10} = 203.642.$$

But does this average represent the truth? Or, rather, how nearly does it represent the truth?

According to the theory of probabilities, the “weight” of α may be determined by means of the formula

$$w = \frac{n^2}{2\Sigma e^2},$$

where n = the number of observations, and Σe^2 = the sum of the squares of the successive differences, obtained by

subtracting *each* observation from the arithmetic mean of the *whole*.

The arithmetic mean of the ten weighings is $\alpha = 203.642$.

The sum of the squares of the ten differences between and each individual observation is—

e .	e^2 .
+0.024	.000576
+0.008	.000064
+0.007	.000049
+0.002	.000004
.000	.000000
−0.003	.000009
−0.004	.000016
−0.006	.000036
−0.010	.000100
−0.014	.000196

$$\Sigma e^2 = .001050$$

Hence the weight of α is

$$w = \frac{(\text{number of observations})^2}{2\Sigma e^2} = \frac{100}{.0021} = 47619.$$

The largeness of this figure indicates the high degree of probability that α is very near to the true value sought. But the question, What is the true value? does not admit of absolute answer; for one of the observations was as low as 203.628, and one as high as 203.666. The number of possible values between 203.628 and 203.666 is infinite, the arithmetic mean α being but one of these values; and although more likely than any other that could be named, it is not more likely than *one or other* of all the possible values. The odds are many to one that α is *not* the truth; but they are also many to one that α is very near the truth. The question “How near?” cannot be answered; alter the question to “What is the probability that the truth is comprised within the limits $\alpha \pm k$?” and the answer may be easily given, *however small k may be*. Thus if $k = .01$,—in other words, if the question be “What is the degree of likelihood that the truth lies between 203.632 and 203.652?”—the answer is given by the formulæ

$$\left. \begin{aligned} \pi &= H, \\ t &= k\sqrt{w}, \end{aligned} \right\}$$

having recourse to tables calculated from the celebrated Definite Integral,

$$Ht = \frac{2}{\sqrt{\pi}} \cdot \int_0^t e^{-x^2} dx.$$

Let—

$$k = .01,$$

$$w = 47619,$$

$$\sqrt{w} = 218,$$

$$\therefore t = k\sqrt{w} = 2.18,$$

$$\therefore \pi = H_{2.18} = .99795.$$

(See Table I., at end of Professor De Morgan’s “Essay on Probabilities.”)

The result, $\pi = .99795$, is so near to unity, the measure of *certainty*, that for every practical purpose it may be considered *certain* that the truth is really comprised within the limits named.

By Table II. in Professor De Morgan’s Essay, we can test the correctness of the preceding deductions; for—

$$\frac{62}{130\sqrt{w}} = \text{the probable error,} \\ \frac{k}{\text{probable error}} = t.$$

Then K , answering to t in Table II., is the probability required.

* A Paper read before the Royal Society June 20, 1872.

† It should be noted that the arithmetic mean of *all* the readings, including the highest as well as the lowest result, in which doubt might arise as to success in manipulation, is 203.6.

‡ Fully illustrated in the preceding text.

Hence—

where $w = 47619$,,, $\sqrt{w} = 218$, $\frac{62}{130 \sqrt{w}} = .0022$, $\frac{k}{.0022} = \frac{.01}{.0022} = 4.6 = t$,

to which corresponds in Table II. $K = 99808$, against 99795, as before.

I may therefore conclude that, within the limits of error (as small as possible) of observation, the

ATOMIC WEIGHT OF THALLIUM = 203.642.

Professor Stas has shown the hypothesis of Prout—that the atomic weights of the elements are severally multiples of the atomic weight of hydrogen—to be without the corroboration of experimental result. This view of the hypothesis is further borne out in the present investigation; for the number 203.642 cannot, within the limit of what has been shown to be the probable error, by any liberty be made to follow the hypothesis. Without doubt, when the atomic weights of all the metals are re-determined according to the standard of recent scientific method, it will be found that there are more exceptions to the hypothesis than are commonly considered. Marignac gives, in his confirmatory discussion of Stas's experiments, and in his own results with calcium (40.21), lanthanum (94.13), strontium (87.25), analogous opposed evidence, as in the case of the weight found for thallium.

In the preceding pages I have given the method by which I have arrived at the atomic weight of thallium, whilst I have endeavoured to show that experimental chemistry is strictly a science of precision. Accordingly, the determination of the atomic weights of other of the elements (gold, chromium, platinum, rhodium, ruthenium, palladium, iridium, lithium, glucinum, cerium, and boron) is not a matter of supererogatory labour undertaken for the sake of verification merely, but is necessary to the progress of chemistry immediately as a science and technologically. For, until these elements shall have assigned to them more accurately their combining numbers, it will not be safe to enter into theoretical speculations respecting the interrelations between elementary bodies, nor possible to estimate them quantitatively without some error, which, small as it may be, yet remains an inaccuracy inadmissible to true science. One of the sources of error (that of neglecting the variation of atmospheric pressure during the weighings), it will have been seen, frequently introduces as much defect from the truth as impurity of the chemicals employed—a fact that has hitherto been greatly overlooked. Undoubtedly, larger errors are sometimes admitted to general chemical manipulation from deficiency or excess in the weights employed than would obtain from the use of materials of ordinary purity, although in the latter case to notice effects of variable pressure, or the loss by weight of air displaced, would be labour wasted.

Bearing these teachings of experience in my mind, I have striven to eliminate all erroneous influence in the number I submit to the Royal Society as the atomic weight of thallium; and I shall be amply rewarded for my long labour if I can know that the determination has secured to researches of this character a nearer approach to the standard of truth.

New Method of Obtaining Potassium.—Sergius Kern writes:—If sulphide of potassium be placed in a cast-iron retort with iron-filings, vapours of potassium and ferrous sulphide are obtained, according to the following equation:— $K_2S + Fe = FeS + K_2$. The potassium by the above process is far cleaner than that obtained by the reduction of potash with carbon; besides this, the formation of the black explosive substance (compound of carbonic oxide with potassium) is avoided.

ON THE METHODS IN USE FOR DETERMINING THE VALUE OF VEGETABLE AND ANIMAL OILS.*

By J. J. COLEMAN, F.C.S.,

Associate of the Institute of Engineers, Scotland

(Continued from page 150).

WE now proceed to an attempt to classify oils on the principles indicated in the earlier portions of the paper.

Class I. contains only one member, sperm oil, which for a long series of years has held the position of the dearest oil in the market.

Its commercial value is dependent upon the fact that only about 3000 tons are imported annually into this country, and secondly upon the fact that for a particular class of work, viz., the greasing of spindles of cotton, woollen, or worsted mills, it has been found to answer better than any other vegetable or animal oil.

The reasons which appear to establish the efficacy of sperm oil for this particular work are the small viscosity of the oil, combined with its freedom from all tendency to gum or dry on the machinery.

A cotton spindle is sometimes scarcely larger than a big penholder; and when there are, say, in one mill 40,000 or 50,000 revolving at the rate of from 2000 to 10,000 revolutions per minute, it is obvious that the great viscosity of other fatty oils would offer a resistance to motion of no mean character. Accordingly, we find oils which would suit an engine or big shafting, when applied to the bearings of a spindle, necessitates the employment of much more power, and, as a necessary consequence, the consumption of more coals than is required when sperm oil is used. The quantity of sperm oil coming into this country is far too small to supply even a fraction of the spinning mills of the United Kingdom. Even twenty years ago the scarcity was felt, the price reaching 20s. per gallon.

The great substitute for sperm oil in our days for this special purpose is mineral oil, which, by suitable combination with other oils, produces a product of the small viscosity or limpidity characteristic of true sperm oil, so that now we find most spinning mills using such preparations. From its scarcity, then, and high price, sperm oil is liable to adulterations.

Now the oils known to be lighter than sperm oil in specific gravity are mineral oil and an oil which comes in small quantity into this country under the name of African fish oil; whilst, on the other hand, the oils known to be heavier than sperm oil are all the other fifty or sixty oils known in commerce, most of them fully 30° or 40° heavier in specific gravity. Sperm oil is peculiarly light in specific gravity; it is stated in chemical books to be 0.875. The three refiners of sperm oil—Millars, Langton and Bicknell, and Messrs. Walls, of Glasgow—are supposed to be reliable, and I have found samples of guaranteed genuine oil from them stand about 0.882 or 0.883, or thereabouts; whether it should be lighter is difficult to say, as it is asserted that the young fish give a different gravity of oil to the old ones, so that we are reduced to the necessity of taking the best commercial oil as a standard. It is clear it should not exceed 0.882.

The specific gravity being correct does not necessarily imply the genuineness of the oil, because the specific gravity could be adjusted by mixing African fish oil or mineral oil with some of the heavier oils. In examining sperm oil it is necessary, therefore, to note the following points:—

- (1). To examine for mineral oil.
- (2). To examine into the drying properties of the oil, which is best done by exposing some of the oil in a thin layer to 200° F. for some hours.

* Communicated to the Chemical Section of the Philosophical Society of Glasgow.

- (3). That the other fish oils darken much more notably than sperm oil when shaken up with dilute sulphuric acid.
- (4). That the most likely adulterant is African fish oil, which produces intense heat when mixed with concentrated sulphuric acid; thus a mixture of 1 part of acid and 4 parts of oil develop about 112° of heat, against a development of heat of upwards of 250° with the African fish oil. The sp. gr. of this African fish oil is said to be about 0.866, and it is a very bad lubricant. (Other adulterating oils may also be detected by this test.)
- (5). That, as the use of sperm oil is dependent upon its viscosity, an accurate test thereof in a suspected sample may be useful.

Class II. come next in value to sperm oil, viz., the oleins obtained by hydraulic or other pressure from animal fats, and known in the market as tallow olein, lard olein, and neats'-foot oil.

These oils have their market value established by the fact that, whilst being of heavy viscosity, they are practically free from tendency to gumming or clogging by the absorption of atmospheric oxygen.

In consequence, they are adapted for wool greasing and machinery of a heavy character. They are, however, generally too dear for wool greasing, and their use is almost confined to machinery purposes.

Now, with respect to neats'-foot oil, its importance is very much exaggerated in chemical books. It is only produced in very insignificant quantity, and from its strong smell, and its dark odour and high specific gravity, it is, of all other oils, the most unsatisfactory to examine and report upon; and there is much reason to believe that the name neats'-foot oil is used merely as a cover for mixtures of very inferior oils, flavoured up with a small dash of fish oils. Practically, the grease from which neats'-foot oil is produced is generally passed on to the soap-boiler; further, it must be observed that what is really valuable in neats'-foot oil is the olein expressed from it, which forms only a portion of the oil of commerce.

It is, however, otherwise with tallow and lard oleins, especially the latter, which is of very great commercial importance, and quite equal to neats'-foot oil in utility.

In examining these oils we have—first, variations in quality produced by carelessness in manufacture, viz., the oil being dark coloured (for both should be nearly white) or having too much smell (for both, and especially lard oil, should be nearly odourless), or else they may have an acid reaction owing to slight rancidity; this applies more particularly to tallow oil.

The variations in quality produced by adulteration will be in the direction of the non-drying properties of the oil being interfered with.

The first step in examining either lard or tallow oil is the specific gravity, which in both cases should be 0.915. If the oil is heavier it may contain fish oils, seed oils, olive oils, or cocoa-nut olein. Olive oil, cocoa-nut oil, or fish oils can be detected by the smell, colour, taste, and Calvert's tests, so that the real difficulty lies with seed oils, one of which, rape oil, is nearly of the colour, and exactly of the specific gravity, of animal oleins.

It will be found that if a sample of animal olein be *too heavy* in specific gravity it will probably contain some of the partially drying oils, of which the chief representative is cotton-seed oil, ranging in specific gravity between 920 and 930. The Americans, indeed, who send over immense quantities of lard oil, actually do adulterate with cotton-seed oil to a large extent, and one can almost calculate the percentage in the one by the increase of specific gravity, and the same remark applies to adulteration with other seed oils. Those seed oils which cannot be detected by variations in the specific gravity are rape oil, henbane seed oil, horse-chestnut oil, and plum-kernel oil. The three last may probably be disregarded, so that the chief point is the detection of rape oil, for which these processes may be indicated.

- (1). Heating the oil to 400° F., and allowing it to cool to 90° . Tallow and lard oils are rendered odourless, whilst the peculiar penetrating smell of rape oil is developed.
 - (2). One part by weight of the oil to be tested is mixed with three parts by weight of concentrated sulphuric acid, and the heat developed is compared with that developed by a similar experiment made with pure oil.
 - (3). The nitrate of mercury test is said to indicate the presence of even 10 per cent.
- Finally, lard oil is distinguished from tallow olein by difference of viscosity.

Inferior descriptions of tallow oil only fit for soap making are often quoted in the market.

(To be continued.)

INDIRECT DETERMINATION OF POTASH AND SODA.

By F. MAXWELL-LYTE, M.A., F.C.S.

I AM not aware that the following mode of indirect determination of the alkalies potash or soda, when they are in the state of neutral sulphates, or can be brought to this condition, has yet been published under the present form.

As it is convenient, rapid, and fairly exact, I venture to give it you. Among other applications it will be found very convenient in the examination of sugar ash, but is useful in a variety of cases.

Having obtained the mixed sulphates free from any other salts, and in solution, I evaporate the mixture to dryness, heat to redness and weigh. I now re-dissolve the salts and estimate the *percentage* of SO_3 they contain by any convenient volumetric or gravimetric method, and from the percentage thus found I subtract the *percentage* of SO_3 the salt would contain were it pure sulphate of potassa. I adopt the figures 45.977 as a sufficiently close approximation to this last-named percentage, and by simply multiplying the remainder by 9.66, the result will be the percentage of sulphate of soda the mixed salts contained.

This result is not absolutely correct, for the multiplier is a little too high, but the error is not 1-10,000th, which is near enough for all intents and purposes.

The result obtained deducted from 100, the remainder will be the percentage of sulphate of potash, and from these results the quantities of each of the alkalies sought may be calculated. I prefer in the present case using the old atomic weights, as they admit of a nearer approximation to truth, with a multiplier of only 2 places of decimals, as given above.

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Paris.

FRIGORIFIC EFFECTS FROM CAPILLARITY COMBINED WITH EVAPORATION.*

By M. DECHARME.

A BAND of porous paper 10 or 12 centimetres long, 2 or 3 broad, folded two or three times lengthwise, or rolled up, is placed with one of its ends in a vessel containing sulphide of carbon. The liquid rises at first rapidly; in less than a minute it reaches a height of 7 to 8 centimetres. Then there appears at the upper part of the paper a uniform white zone of hoar frost, proceeding either from the condensation of the vapour in atmospheric air, or from the formation of a hydrate of sulphide of carbon. The layer gradually increases, and thickens and descends to about 2 centimetres above the surface of the liquid in the vessel; then the ascent of the liquid appears to be quite stopped.

* Abstract of a recent paper to the French Academy.

Still, if the liquid does not pass the zone of hoar frost, the capillary aspiration continues none the less active in this zone itself, where one may soon see arborescences growing out perpendicular to the surface of the paper. These arborescences reach in half an hour 12 to 15 millimetres length in certain cases. Grouped together they present the aspect in miniature of masses of trees covered with hoar frost, or of fungi, or of heads of cauliflower. The phenomenon may continue indefinitely, provided one adds liquid from time to time to replace that which is volatilised. The arborescences begin to melt only some minutes after the sulphide of carbon has been completely exhausted.

Their formation is little retarded in full sunlight at a temperature of 35° . Further, when the liquid is heated in a water-bath with water at 60° , the phenomenon of hoar frost also appears, while the sulphide of carbon is in ebullition. The arborescences, though more rare and slender, are often longer than when produced in cold.

To estimate the lowering of temperature produced, the bulb of a small thermometer is wrapped in porous paper, and the instrument is so placed that the lower part of the paper is immersed in sulphide of carbon, the bulb being about 3 centimetres from the liquid surface. The layer of hoar frost is formed, and thickens, and the mercury descends in a few minutes from $+20$ to -15° .

It is even sufficient to plunge the thermometer, wrapped in its band of paper, into the liquid, and immediately to withdraw it, in order to the white layer appearing; and in less than two minutes the mercury descends from $+20$ to -12° , sometimes to -16° , if one agitates the instrument in air. It is to be remarked that in the liquid left to spontaneous evaporation, the thermometer with porous paper only falls to $+5^{\circ}$, the temperature of the surrounding air being 15° or 18° .

A band of porous paper being simply immersed in sulphide of carbon, then immediately withdrawn, the zone of hoar frost in 20 or 30 seconds is seen to form, to increase during about a minute, then to melt. We have here a means of ascertaining at once, even in sunlight, the presence of aqueous vapour in atmospheric air. In foggy weather the phenomenon is more rapid, the deposit more abundant, and the cold more intense: thus we have a hygroscope of great simplicity.

It is easy to pass from the foregoing experiments to that of congelation of water; we have merely to wrap in a band of porous paper a small tube of thin glass, containing 2 or 3 centimetres of water, immerse it in sulphide of carbon, and draw it out immediately. The freezing of the water takes place in 2 minutes; when the air is dry, a second immersion is sometimes necessary.

If one makes the experiment with a tube 1 centimetre or more in diameter, the capillary aspiration and the evaporation have to be continued a longer time; with this view, the paper is so arranged that the maximum of cold is produced about the middle of the column of water, and it is plunged 1 centimetre in the liquid. One obtains in 15 minutes or half an hour (the column of water not being over 5 centimetres length) a beautiful cylinder of ice, the thickness of one's finger. If the evaporating process is stimulated by ventilation, or with the air-pump, the effects are still more rapid and intense. I am at present seeking for some convenient method of condensing the vapour of sulphide of carbon and rendering the operation practical.

Chloroform also produces phenomena of arborescence in porous paper, but less readily than sulphide of carbon. Sulphuric ether, though very volatile, does not produce them.

When one examines with a small microscope (20 or 30 diameters) the tops of the arborescence in process of development, one perceives in them a movement which does not at all resemble that of the crystallisations which are projected in the solar microscope. The thing looks like a moist paste in rapid fermentation; there are risings and sinkings, a kind of head will rise, then subside, then appear again, and with such rapidity sometimes, that the eye has difficulty in following the different phases.

The phenomenon is only limited by the exhaustion of the liquid. It appears then that the arborescences are not of crystalline character, although there is a certain similarity in their structure. After exhaustion of the liquid, the terminal branch shows small crystalline points, which are, however, opaque, and as if efflorescent.

It is possible to project the arborescences by means of M. Duboscq's new apparatus with inclined mirror, which magnifies sufficiently for the effect. This makes a very good lecture experiment.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 2nd, 1874.

Dr. ODLING, F.R.S., President, in the Chair.

THE minutes of the previous ordinary meeting and of the anniversary meeting having been read and confirmed, and the donations to the library of the Society announced, the following names were read for the first time:—Messrs. John McLachlan Glassford, George Jarman, William Bettel, Arthur Brotherton Allen, and Maurice Lichtenstein.

For the third time—Messrs. H. Critchett Bartlett, A. J. Greenaway, William Cunningham, George Henry Beckett, George Smith, and Capt. Mackay Heriot, who were ballotted for and duly elected.

The first paper, "*On Sulphocyanide of Ammonium and Sulphocyanogen*," by Dr. T. L. PHIPSON, was read by the Secretary. After referring to a paper on this subject read before the British Association, at Norwich, the author remarks that the ammonium sulphocyanate produces a very great degree of cold when dissolved in water, and, as might be expected, develops much heat on crystallising, so that when a large crystal is formed the smaller adjacent ones dissolve again; the alcoholic solution presents in a high degree the phenomenon of supersaturation. The concentrated aqueous solution of the sulphocyanate dissolves iodine, and, when diluted and heated, the brilliant yellow compound called sulpho-cyanogen is deposited, and the liquid becomes colourless. Bromine acts in a similar manner. With chlorine the action is very complicated; for although some sulpho-cyanogen is obtained, along with other products, in concentrated solutions, with weaker ones the sulphur is gradually oxidised to sulphuric acid. The amount of ammonium sulphocyanate in a solution may be very conveniently and accurately determined by acidulating with hydrochloric acid and precipitating with a mixture of equal equivalents of the sulphates of copper and iron. The precipitate, dried at 100° , has the composition CuCNS . The author recommends the sulpho-cyanogen as a pigment of extraordinary brilliancy, for it can be ground up with 90 parts of white, and even then, when mixed with oil, it requires more white to bring it to the colour of chrome-yellow. Sulpho-cyanogen which, when dried at 108° , has the composition CNS is soluble in sulphuric acid, and is re-precipitated by water. It is decomposed, with effervescence, by nitric acid. Sodium also acts on it with violence, producing sodium sulphocyanide and sulphide. The author concludes his paper with some theoretical remarks on the constitution of sulphocyanogen, ammonium sulphocyanate, and sulpho-urea.

The PRESIDENT, in thanking the author, said that no doubt the method of precipitating as copper salt would be found useful for determining the amount of ammonium sulphocyanate in the commercial sulphate.

Mr. CLOWES said he could confirm the statement of Dr. Phipson as to the great depression of temperature produced during the solution of the ammonium sulpho-

cyanide. In an experiment he had made he had observed a temperature of -8°C .

The next paper, a "*Note on a Reaction of Gallic Acid*," by Mr. H. R. PROCTER, was then read by the Secretary. The author finds that, on adding a solution of sodic or potassic arsenate to one of gallic acid, the liquid absorbs oxygen from the air, and assumes an intense green colour, which changes to purplish-red by the action of acids. The test is very delicate if care be taken to avoid excess of alkali in the arsenate, but the presence of pyrogallol seems to interfere with the reaction. Oxidising agents change the colour to brown, and reducing agents likewise destroy the colour. Sodium hyposulphite renders the green paler. The green colour is not removed from the aqueous solution by agitation with ether, benzene, or bisulphide of carbon.

The PRESIDENT having thanked the author in the name of the Society, Mr. W. NOEL HARTLEY read a communication "*On the Cobalt Bromides and Iodides*." Metallic cobalt, placed in a dish with bromine and a little water, and allowed to stand for a week or so, dissolves, forming a purple solution, which on concentration becomes blue. If allowed to stand over sulphuric acid, it now deposits purple-red prismatic crystals, having the composition $\text{CoBr}_2 \cdot 6\text{H}_2\text{O}$. Heated to 100° it fuses, loses water, and on cooling a mass of purplish-blue crystals are obtained, of the formula $\text{CoBr}_2 \cdot 2\text{H}_2\text{O}$. At 130° it becomes an amorphous brilliant green-coloured mass, which is the anhydrous bromide CoBr_2 . The iodide is prepared in a similar manner to the bromide, and on evaporating the solution, and allowing it to stand, a compact mass of green crystals, having the composition $\text{CoI}_2 \cdot 2\text{H}_2\text{O}$, is formed. This salt is exceedingly deliquescent, absorbing water even more readily than calcium chloride. When dried at 100° it continuously loses weight, a portion of the iodine in the salt being replaced by oxygen. On evaporating a solution of cobalt iodide until it becomes green, and cooling it to 16°C ., it assumes a brown colour: this, on standing a day or two, deposits large hexagonal prisms, of the colour of smoky quartz, having the formula $\text{CoI}_2 \cdot 6\text{H}_2\text{O}$. When dried at 130°C . it leaves anhydrous cobalt iodide, CoI_2 , which is black and lustrous like graphite.

Dr. ODLING said they were much obliged to Mr. Hartley for his interesting paper, which illustrated so admirably the explanation that the variation in the colours of the cobalt salts is due to the difference in their hydration.

In reply to a question from the President, the author said that he had never spectroscopically examined the colourless solution obtained on mixing a green solution of a nickel salt with a pink cobalt solution.

Mr. CLOWES stated that a dilute solution of cobalt chloride, which did not change colour when heated to 100°C ., became blue on exposure to a comparatively high temperature in a sealed tube.

Mr. E. NEISON then read a paper on "*The Distillation of Sodium Ricinoleate*." According to Bouis, when sodium ricinoleate is distilled, it yields methyl-ethyl-keton, whilst Städelér says it gives nothing but heptylic aldehyd. Castor oil was therefore saponified by an excess of sodium hydrate, and the resulting soap salted out. This, when strongly heated in a copper flask, yields a liquid distilling entirely between 172° and 176° ; in fact, 85 per cent came over between 172° and 173° , and was recognised as pure methyl-ethyl-keton. A castor-oil soap, prepared with a much smaller quantity of alkali, when distilled gave a brownish oil, of which but little more than 50 per cent came over below 200°C ., the remainder consisting of neutral oils and fatty acids. The lower boiling-point portion, by fractionation, yields a large amount of heptylic aldehyd. From these results it would seem that the apparently contradictory statements of Bouis and Städelér are both correct, the difference arising from the nature of the soap used—one containing an excess, the other a deficiency, of alkali.

The PRESIDENT thanked the author for his paper in

which he had so satisfactorily made out the conditions of the production of the compounds mentioned.

In reply to a question of Dr. Armstrong as to the manner in which he had made the estimation of the amount of the various products obtained, the author said that by careful fractional distillation in one case he had separated 85 per cent of the methyl-ethyl-keton boiling at 172° to 173° , and in the other more than half of heptylic aldehyd boiling between 153° and 156°C .

Mr. C. H. PIESSE read a "*Note on the Solubility of Plumbic Chloride in Glycerin*." He had made careful determinations of the solubility of plumbic chloride in pure glycerin, and in mixtures of glycerin and water, by agitating the finely divided chloride for a considerable time with the heated liquid, and then precipitating the dissolved lead as sulphate. The results show that pure glycerin dissolves 1.995 per cent of plumbic chloride; dilute glycerin, containing 50 per cent of water, 1.32 per cent; that containing 75 per cent of water dissolves 1.036 per cent of the chloride, and a solution containing 87.5 per cent water, 0.91 per cent.

In reply to a question of the President, the author said that plumbic sulphate was almost insoluble in dilute glycerin.

Mr. C. T. KINGZETT read a communication "*On Ozone as a Concomitant of the Oxidation of the Essential Oils; Part I.*" It is generally stated in the text-books that the oxidation of oil of turpentine is accompanied by the production of ozone, although there has always been more or less doubt about its formation by this means. The author, after making numerous experiments on the variation of absorption of oxygen by different essential oils, and testing them with the potassium iodide starch mixture, fixed upon oil of turpentine as the most convenient for experiment. He found that the oil after exposure to air acquired the property of giving a blue colour to a solution of chromic and sulphuric acids, and of colouring potassium iodide starch mixture in a manner similar to ozone and hydrogen peroxide, but it produced no action on acetate of lead paper or sulphate of manganese paper. This property is not destroyed by washing the oil with water, even when air is excluded. Oil of turpentine was mixed with an equal bulk of water and partly distilled, both the aqueous and oily residue in the retort gave the colour reactions above mentioned, whereas the distillate did not, from which the author infers that they cannot be produced either by ozone or hydrogen peroxide, as these would be destroyed or removed during the distillation. Since it is destroyed when heated with zinc chloride even at 75°C ., and also by sodium hydrate at 110° , he feels convinced that the substance producing the colour reaction is the monohydrated oxide of turpentine, $\text{C}_{10}\text{H}_{16}\text{O} \cdot \text{H}_2\text{O}$. The author finds that many deoxidising agents likewise destroy it.

Dr. ODLING said they were much obliged to Mr. Kingzett for his paper on a subject which had so much attracted the attention of chemists. Although evidence that ozone is formed during the oxidation of turpentine is altogether wanting, on the other hand he hardly thought the non-existence of peroxide of hydrogen was quite established, for it was a much more stable compound than is generally supposed. There were one or two points he would like to offer for his consideration. It had not been proved that hydrogen peroxide was more soluble in water than in turpentine, and therefore it was possible that it would not be washed out of the latter by water. Again, with respect to the treatment with zinc chloride destroying the property which the oil had of giving these colour tests, it was not known what the effects of zinc chloride might be on peroxide of hydrogen.

Mr. GROVES asked the author as to whether he believed that the property which ether and the paraffins in petroleum acquired during slow oxidation of giving these colour tests, was due to the formation of a peroxide of ethyl or a peroxide of the paraffin.

The author said he was studying the action of zinc

chloride, and hoped to treat of it in a second paper. With respect to the oxidation of ether, he had not investigated the subject himself, but understood that this property was connected principally with the air over the ether.

The last paper on the "*Action of Chloride of Benzyl on Camphor; Part II.*," by Dr. D. TOMMASI, was read by the Secretary. By careful fractionation of the oils mentioned in the first part as obtained by the action of benzyl chloride on camphor, the author succeeded in isolating the following substances:—A liquid boiling between 151° and 152° , having a composition $C_{10}H_{14}$ or $C_{10}H_{16}$. In the former case it would be an isomeride of cymene, in the latter of terebene. Also a benzene derivative boiling at 176° to 178° C., and having the formula $C_7H_{10}O$: a compound boiling at 189° to 190° , of the composition, $C_{10}H_{14}O$, and therefore an isomeride of oxycymol and carvol, and, lastly, a liquid, $C_{16}H_{24}O$, boiling at 203° to 204° . The two last-mentioned bodies yield crystalline derivatives by the action of bromine. The substance, $C_{10}H_{14}O$, moreover, gives a nitro-compound heavier than water.

The PRESIDENT having thanked the author, adjourned the meeting until Thursday, 16th of April, when papers will be read "On some Isomeric Terpenes and their Derivatives (Part IV., Oil of Cajepu), by Dr. C. R. A. Wright, and "On the Constitution of Urea," by Dr. D. Tommasi.

NOTICES OF BOOKS.

The Royal Commission on Scientific Instruction and the Advancement of Science.

THE Commission has not been idle. It has just issued a fourth Report. The former reports treated mainly of Science teaching, and the conditions of Science instruction in schools throughout the country, while the present Report discusses National Scientific Museums and Collections. The Commissioners consist of—Two noblemen of considerable influence (both are in the House of Lords, and one of them is an elected trustee of the British Museum, and has been Chancellor of both the Universities of Cambridge and of London); also of two eminent physiologists, and two eminent mathematicians, one of whom is also a distinguished physicist; and, finally, of three well-known men of varied attainments,—all sincerely penetrated by a devotion to Science. When Dr. Miller was alive there was also a chemist among the Commissioners. The work has been well done. The Royal Commissions of the present age and parliament are not like those of fifty years ago.

The first part of the Report gives some interesting details concerning the administration of the British Museum, from which we learn that it is governed by no less than *fifty* trustees, twenty-five of which are *ex officio*. It has for some length of time been a question open to much difference of opinion whether personages such as the Archbishop of Canterbury, the Lord Chancellor, the Speaker of the House of Commons, and the First Lord of the Treasury, who have important duties to fulfil elsewhere, can adequately make appointments to the various offices in the Museum, and watch over its interests in every direction. The Commissioners do not give any opinion in regard to this broader and more general question, but they are of opinion "that the objections to the present system of government of the British Museum by a Board of Trustees, as at present constituted, so far as relates to the Natural-History collections, are well founded; and we have been unable to discover that the system is attended by any compensating advantages." The Commissioners accordingly suggest that a Director of the Natural-History collections should be appointed by the Crown, and that he should be entrusted with the entire control of the department, and be immediately responsible

to a Minister of State. It has been decided to remove the Natural-History collections to South Kensington, and we believe a suitable building is now being erected for them.

In regard to the Hunterian Museum of the College of Surgeons (to the perfecting and maintenance of which the nation has contributed £57,500), it is suggested that no change be made, and that, if the necessity should ever arise, "it should receive support from the State, as an Institution intimately connected with the progress of Biological Science in this country." This is a very wise conclusion to have arrived at, for although portions of the collection would no doubt admirably supplement the British Museum zoological collections, the former, if removed from the College of Surgeons to South Kensington, would be far less accessible to medical students than they are at present.

The National Botanical Collections and Gardens at Kew are next discussed. The herbarium at Kew is remarkably good, while that at the British Museum is perhaps the finest in the world. It has been proposed to unite them, but the Commissioners do not adopt this view. The Kew herbarium was founded by Sir William Hooker, and at his death, in 1865, was purchased by the Government. For forty years it has received almost all the collections made by Government expeditions. The Gardens occupy 300 acres, and are believed to contain 20,000 *species* of plants. A number of gardeners are annually trained there, who are afterwards employed in some of our Colonies abroad. The principal recommendation made by the Commissioners in this regard is the following:—"That the collections at the British Museum be maintained and arranged with special reference to the geographical distribution of plants and to Palæontology; and that the collections at Kew be maintained and arranged with special reference to Systematic Botany."

We are glad to see that the Commissioners recommend the formation of a cabinet of physical and mechanical instruments, similar to that in the *Conservatoire des Arts et Metiers*. They further recommend the establishment of courses of lectures on scientific subjects, both in connection with the collection of apparatus and otherwise. This system has already been adopted to some extent. For several years lectures have been given at the School of Mines to working men, and long courses of lectures are now becoming general during the winter session in all our larger towns.

What we have now most to hope is that the valuable Report of the Science Commissioners will receive the earnest attention of both Houses of Parliament, and that the subject will be thoroughly discussed. A great step will be gained when the whole educational system—scientific and otherwise—of the country is placed under the control of a Minister of State, whom we would willingly call the "Minister of Public Instruction." We do not know whether by the late election we have lost any Members who were devoted to Science and to Education, and who would have led the discussion of the subject in the House, but we may at least console ourselves with the fact that many Members of the new Parliament are devoted to the educational interests of the country, and will no doubt bring forward the suggestions of the Commissioners and their own comments during this present Session.

Adulterations of Food, with Short Processes for their Detection. By R. J. ATCHERLEY, Ph.D., F.C.S. London: Isbister and Co.

DR. ATCHERLEY is not free from "the last infirmity of noble minds." In the brief compass of 112—or rather 100—small and widely-printed pages, he undertakes to supply consumers and dealers with "easy and practical tests as to the purity of articles of food, and to give "processes of great accuracy, and requiring considerable experience in the manipulation," for the benefit of professional analysts. The methods described, we are told

in the preface, are "the best in use at the present time," and all have been "found by the author to be trustworthy."

The plan of the work is simple: the various articles of food and drink are given in alphabetical order. Under each are mentioned the "probable adulterations," with their methods of detection, chemical or microscopical. Now, without at all questioning the value of the processes selected, we cannot help thinking that much of the information here given is superfluous for the chemist, and, on the other hand, altogether insufficient for the general reader. Thus, we have on page 2 instructions for the determination of sulphuric acid. The chemist does not need them, and the non-chemist will scarcely be able to perform the operation aright without more minute and detailed directions.

For the detection of picric acid in beer, the author gives a new test, distilling the "extract" with a solution of chloride of lime, when picric acid, if present, may be at once recognised by the peculiar and penetrating odour of the chloropicrin that passes over. We do not see that this process is superior to the old one of boiling in the suspected sample a little clean white woollen yarn, which, if picric acid be present, is dyed a fine pale yellow. Turning to the section on Bread, we are glad to find that the author does not recommend the "alum test." The observation that, if potatoes have been added, the aqueous extract of the bread will be neutral and the ash alkaline, is important.

The "probable adulterants" of butter form, according to the author, a long and revolting list:—"Water, salt, silicate of sodium, chloride of calcium, starch, potatoes, flour, cheese-stuff, rag-pulp, gelatine, beef and mutton suet, and various other fats." Of "rag-pulp," as an intentional adulteration, we never met with, nor heard of, an authenticated instance. Indeed, considering that salt and water can be incorporated with butter to the extent of 35 per cent, there seems little temptation for adulterators to try other sophistications. Under Ketchup, the author furnishes what must be regarded as full proof of its adulteration with the juice of putrefying livers of horses. For such frauds the existing Adulteration Act is far too lenient.

In speaking of cheese, the author quotes, from Normandy, a case of several persons poisoned by eating cheese coloured with anatto, which had been adulterated with red-lead. Such cases we consider to be very rare. Dyers and printers do not find anatto adulterated; and, on the other hand, it must be remarked that cheese perfectly free from any mineral impurity has sometimes been known to produce all the symptoms of an irritant poison. Dr. Atcherley omits, among the impurities of cheese, to mention potatoes and farina, which we have repeatedly found in Lincolnshire cream-cheese.

In cocoas and chocolates, it is open to question how far sugar is to be considered as an adulteration. In treating of milk, we regret to find the author still attaching a certain value to the indications of the lactometer. As Mr. Wanklyn has clearly shown in his recent work on "Milk Analysis," the fraudulent dealer, by removing cream, raises the specific gravity of his milk, and, by adding water, lowers it again to its former standard. In his instructions for the determination of the casein and fat, the author recommends the addition of plaster-of-paris. Mr. Wanklyn, as our readers will doubtless remember, cautions the student against such an admixture.

The adulteration of raw sugars with such substances as sand, gypsum, chalk, &c., whatever may have been formerly the case, is now very rare. We know that chemists have in vain attempted to meet with such samples, even in the lowest districts of London.

Under Tea, the author mentions iron filings among the probable adulterants, a point recently disputed. Why, by the way, does not Government legalise the sale of sloe-leaves as an admixture in tea, the purchaser being informed thereof by label or otherwise? They approach quite as near to tea as chicory does to coffee. In speaking

of the adulteration of wines, Mr. Atcherley gives, on the authority of Dr. Muter, the statement that unadulterated port wine will float for a time on the surface of water, whilst, if elder-juice or brandy has been added, it sinks at once to the bottom. That elder-juice may have an "alacrity in sinking" we can well believe, but we should require high authority before admitting that the addition of brandy, a liquid specifically lighter, caused wine to sink in water.

The last twelve pages are devoted to the preparation of standard solutions, and there are also figures showing the microscopic characters of starches, coffee, cocoa, &c.

The Whole History and Mystery of Beet-Root and Beet-Root Sugar. By E. LEFROY CULL, of the Canada Company, Toronto. Toronto: Globe Printing Company.

THE author of this pamphlet wishes to introduce the cultivation of the beet-root and the manufacture of beet-root sugar into Canada. He maintains that the roots grown in Canada are as rich in saccharine matter as the best French or German samples, and he gives very plain directions as to the method of extracting the sugar, and refining it, so far as to fit it for home consumption, and for the use of the professed refiner.

There is, however, one passage which requires a word of comment, and of warning for the public:—

"In all the departments in France and in Germany where beet-sugar is grown and manufactured, the yield of wheat produced by those departments has been more than doubled, and that notwithstanding that potash and soda is made from the refuse of the sugar and sold and taken away from the land, thus really depriving the land of important mineral constituents,—so fertilising to the farms is found the feeding of the beet-root pulp, and the increase of manure from the numbers of cattle kept on it, in spite of the loss of potash and salts in the sugar-crop."

Unless the supply of potash in a soil is unlimited, or can be created by the beet-root, or by the cattle fed on the pulp,—three utterly absurd suppositions,—the loss of potash must be supplied by some specific manure, or the land must sooner or later be reduced to complete sterility. In Germany the loss of potash is very generally compensated by the use of Stassfurt salts. We should strongly advise the Canadians not to sell the potash away from the land without some mineral is accessible which may supply the deficiency. If this last precaution is attended to, we quite agree with Mr. Cull that the cultivation of beet-root will improve the condition of the soil, and prove a valuable feature in Canadian agriculture.

Introduction to the Study of Organic Chemistry. By HENRY E. ARMSTRONG. London: Longmans, Green, and Co.

THIS work,—one of Messrs. Longmans' well known series of "Text-books of Science,"—is in its aim not descriptive, but systematic. The author confines his attention to compounds whose constitution and mutual relations have been determined, and leaves the reader to look elsewhere for information on bodies less thoroughly known.

After instructions on determining the ultimate constituents of organic compounds, the author enters upon formulæ. Whilst regarding "graphic" formulæ as a "more developed form of rational formulæ," he is sparing in their introduction. He gives indeed this most valuable and necessary caution!—"The use of these terms seems to imply, however, that such formulæ express the constitution or structure of the bodies to which they refer; but we must guard ourselves most carefully against this impression, since, hypothesis aside, we possess no real knowledge as to the internal constitution of chemical compounds, or of the mode of arrangement of the atoms of which bodies are presumed to be made up."

Such a caution coming from such a quarter is doubly valuable. We fear there are teachers of chemistry not a few who suffer their students to go away with the notion

that "graphic" formulæ represent the actual relative positions of the atoms which make up a compound—a hypothesis which, to say the least, is far from proven. In the classification of the carbon compounds, the author does not adopt the common division into the two main groups of fatty and aromatic substances. In so doing we believe he is justified by facts. Certainly every dichotomous classification should, *a priori*, be regarded with great suspicion.

The tables of the homologous and isomeric substances of the different series are an interesting feature of this work and are likely to prove very useful to students.

CORRESPONDENCE.

SPECIFIC GRAVITY BOTTLE FOR SPONTANEOUSLY INFLAMMABLE LIQUIDS.

To the Editor of the Chemical News.

SIR,—In the March number of the *Journal of the Chemical Society* Mr. J. B. Hannay has made some observations intended to refer to the modification of Regnault's specific gravity bottle, suggested by me to meet the requirements of spontaneously inflammable liquids.

"The sole object," remarks Mr. Hannay, "of the modification is to allow of the liquids being poured quickly into the bulb." This passage alone exhibits, on the part of the writer, a complete want of knowledge of the contents of my note on the subject (see *Phil. Mag.*, October, 1873; *CHEMICAL NEWS*, vol. xxviii., p. 211). The fact is, the modification necessarily increases the difficulty of filling: hence the sentence in my paper—"A pipette with a capillary tube will be found convenient for introducing the liquid."

"When once the water-values have been determined for each division on the neck, it will be seen that it is only necessary to fill the bottle so that the surface of the liquid shall fall within the range of the graduations. Another advantage is that the contents can be raised or lowered to the normal temperature, and the volume read off without addition or subtraction of liquid." The object of the modification being thus expressed in my paper, I can understand the general tenour of Mr. Hannay's observations only by assuming that he has not even seen that which he has succeeded so well in misrepresenting.

After annihilating my bottle, the warrior modestly continues—"The apparatus above described (*i.e.*, Mr. Hannay's), however, is admirably adapted for any of these liquids"—such as zinc ethyl. But Mr. Hannay makes no mention of having tried the experiment.—I am, &c.,

ALFRED TRIBE.

April 8th, 1874.

RE-VALUATION OF SALT-CAKE OR CRUDE SULPHATE OF SODA.

To the Editor of the Chemical News.

SIR,—The method usually adopted in Widnes (the great centre of salt-cake manufacture) is as follows:—

The free acid (H_2SO_4) is determined by standard sodic hydrate.

The undecomposed NaCl is determined by standard argentic nitrate.

Then 75 per cent is allowed for silica and ferric oxide, and this allowance I find to be practically correct.

The difference is then called Na_2SO_4 .

Some few chemists, after determining the NaCl and H_2SO_4 as above, titrate with standard BaCl_2 , and deduct the free H_2SO_4 from the total so obtained, and calculate the difference into Na_2SO_4 ; but this is obviously no improvement, and takes a much longer time.—I am, &c.,

R. J. TINNISWOOD.

Radcliffe near Manchester,
March 30th, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, February 16, 1874.

Acid Waters Arising in the Volcanoes of the Cordilleras.—M. Boussingault.—The water is found acidified by sulphuric acid and hydrochloric acid, the origin of which the author traces.

Mechanical Equation which Corresponds to the Equation $\int \frac{dQ}{T} = 0$.—M. Clausius.

Report on Memoir of M. Marey on the Point of Support of a Wing on the Air.—The Committee briefly review the course of M. Marey's researches approving (with slight reservation) the results given in a recent note, and speaking highly of the methods adopted for registering movements.

New Typographic Model Map of Mont Blanc.—M. Viollet Leduc.

Action of Fresh Water on Metallic Lead; Researches by the Electrolytic Method.—MM. Mayercon and Bergeret.—Sulphide of lime is soluble in fresh water, and in water saturated with sulphuretted hydrogen. The latter gas does not show lead in a liquor unless the metal is in certain quantity. Calcareous and gypseous river-water dissolves metallic lead. The Saint Etienne water contains lead, but in too small quantity to be hurtful.

Method of Determination of the Density of Vapours.—M. Croullebois.—The ordinary methods are unsuitable for some volatile substances which take fire spontaneously on contact with air, or are easily decomposed by various influences, or whose maximum tensions of vapour are not known between limits of temperature where the compound is stable. An example is liquid phosphoretted hydrogen. In the author's method a glass vessel $1\frac{1}{2}$ litre capacity, with well calibrated tube 1.20 m. long and 0.02 diameter, is filled with mercury, and inverted over a deep vessel of mercury. A capsule containing the liquid to vapourise is passed in and broken against the wall of the tube, on which vapourisation occurs, and the depression of the mercury is noted. Suppose the tube raised to increase the capacity. If there remain an excess of liquid at the same temperature the height of the mercury column will be unchanged. If, on the contrary, the liquid be entirely vapourised the vapour will behave like a gas subject to Mariotte's law, and the height of the mercury column increase.

Movements of Chlorophyll in Selaginellas.—M. Prillieux.

Relations which may exist between Thermo-Electric Properties and Crystalline Form.—M. Friedel.—The author's results are somewhat in opposition to those of the late M. Rose.

Preservation of Wood by means of Sulphate of Copper.—MM. Boucherie.—M. Hatzfeld questions the preserving power of sulphate of copper, and prefers the acid tannate of protoxide of iron. M. Boucherie contests this view, and points out the necessity of using a pure sulphate of copper, as samples containing 5 or 6 per cent of sulphate of iron give unsatisfactory results.

Facts Relative to the History of the Yeast of Beer.—M. P. Schützenberger.—The sample examined contained 29 to 30 per cent of solid matter. If boiled and washed with hot water it left an insoluble residue of from 20 to 21.5 per cent. If stirred up in water and allowed to stand for twelve to fifteen hours at a temperature of 35° to 40° C., it gives up to boiling water 17 to 18 per cent of soluble

matter; the insoluble residue, dried at 100° C., weighs 12.5 to 13 per cent. The extract contains a notable amount of phosphates; a gummy matter resembling arabin; leucin and tyrosin; carnin, xanthin, guanin, and hypoxanthin. Urea, uric acid, creatin, and creatinin were not detected. Inorit and inoric acid are still to be sought for.

Observations Relative to the Recent Communication of M. Gernez on the Efflorescence of the Two Hydrates Formed by Anhydrous Sulphate of Soda.—A controversial paper in reference to communications read (*Comptes Rendus*, Jan. 19 and 26, 1874).

The Anti-fermentescible and Antiseptic Properties of Solutions of Chloral Hydrate.—MM. Dujardin Beaumetz and Hirne.—The authors find that solutions of chloral hydrate prevent the decomposition of a number of albumenoid and other animal matters, such as albumen, meat, milk, urine, &c.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin
No. 2, February 9, 1874.

Fluctuations in the Chemical Action of the Solar Spectrum, and on an Apparatus for its Measurement.—Herman Vogel.—Along with the action of various absorbents the author wished to determine with accuracy the chemical influence of the solar spectrum upon pure bromide of silver. He found it, however, impossible to obtain identical results. The action passed sometimes into the violet and ultra-violet, and at other times far into the yellow and red. It was found by special experiments that this fluctuation was not due to a varying sensitiveness of the plates. Hence the cause of the fluctuations had to be sought in changes in the relative intensity of the colours themselves. It is known that when the sun is low, and its rays have to pass through a greater thickness of the atmosphere, the intensity of the violet end of the spectrum decreases more rapidly than that of the red. In the spectrum of the setting sun violet is often absent (Maclear). Bunsen and Roscoe observed that the chemical power of different rays is extinguished by the atmosphere in different degrees at different times of the day. Both these chemists, however, have devoted very few experiments to this subject, and have occupied themselves with the determination of the total chemical action of sunlight, without reference to the share of every single colour in such action. They observed the decrease of the total intensity of the sun's rays with the decreasing altitude of the sun, and with the rise of the barometer. Their photometer, not very sensitive for red, yellow, and green, scarcely admitted the observation of fluctuations in the chemical action of the red end of the spectrum. The bromide of silver plates show these variations very distinctly. All the observations were made with a cloudless sky, and considering the short space of time in which the phenomena were observed, it is not very probable that they were due to changes in the surface of the sun itself. A full description of an apparatus for registering these changes photographically is announced.

Sulpho-urea and Guanidin.—J. Volhardt.—The author has obtained guanidin from sulphocyanide of ammonium.

On Cyanamid.—J. Volhardt.—The author describes a new and productive method of obtaining cyanamid. He takes an aqueous solution of sulpho-urea, not quite saturated, and prepared in the cold, and treats it with yellow mercuric oxide carefully washed. The oxide, which must be previously stirred up into a paste with water, is added very slowly in small portions. An excess of mercury is carefully to be avoided.

Preliminary Communication on the Production of Constant Normal Flames.—V. Wartha.—This paper is unintelligible without the accompanying illustration.

Remarks on Opium Bases.—O. Hesse.—A preliminary communication with reference to Dr. Wright's paper (*Berichte*, vi., 1551).

Nitro-Compounds of Inosit.—H. Vohl.—The author finds, in contradiction to his former results, that not one but two nitro-compounds are obtained by the action of concentrated sulphuric and nitric acids upon anhydrous inosit, namely, $C_6H_6(NO_2)_6O_6$ and $C_6H_9(NO_2)_3O_6$.

Phosphorite from Estremadura.—B. Niederstadt.—This phosphorite is brought especially from Logrosan, and is met with in commerce in the shape of hard, stoney, tuberous-looking lumps, about the size of a man's fist, and of a yellowish red colour. Its small percentage of iron and alumina, which together do not reach 2 per cent, gives it a great advantage over the phosphorite of the Lahn, as it yields superphosphates which do not become "reduced" on keeping. The percentage of quartz and of carbonate of lime is a drawback. The superphosphate obtained is dry and granular. Subjoined is the analysis of a sample of this mineral, ex *Porto Packet* :—

Phosphate of lime (tricalcic) ..	25.052
Phosphate of magnesia	3.798
Carbonate of lime	8.066
Sulphate of lime	1.200
Ferric oxide	0.621
Alumina	0.165
Fluor calcium	1.520
Manganese	trace
Silica	25.720
Water	0.250

99.242

Total phosphoric acid 28.850 per cent.

Analysis of a Mineral from Orawicza.—J. V. Janovsky.—

Silica	30.73
Alumina	22.24
Ferric oxide	0.41
Ferrous oxide	3.01
Lime	37.93
Magnesia	6.10
Loss on ignition	0.37

100.79

The specific gravity is 3.01 (see vol. vi., heft 19).

Oxidation of Ortho-Toluic Acid obtained from Liquid Synthetic Dimethyl-Benzol by means of Chromic Acid.—Paul Jannasch.—The result obtained was an unimportant quantity of paraphthalic acid, no isophthalic acid being formed.

Basicity and Constitution of Iodic Acid.—Julius Thomsen.—The author concludes, that the proportions of water being equal, 1 molecule of periodic acid and a double molecule of iodic acid occupy the same volume, and that iodic acid is bibasic, and is to be expressed by the formula $I_2O_6H_2$.

Theory of Fermentation.—M. Traube.—The author, in a treatise published 1858, ascribed the action of yeast and similar ferments to their affinity for oxygen. Proceeding on this hypothesis he suspected that inorganic bodies, capable of attracting oxygen, must have an action upon sugar resembling that of yeast. He finds that at 150° to 160° platinum black splits up sugar dissolved in water. Carbonic acid is given off, and a volatile body with an odour like that of acetic ether, and which on the addition of chloride of calcium is separated from the water as a light oil, and gives with iodine and potash the well-known iodoform reaction.

Action of Cyanate of Potassa upon Sarkosin.—E. Salkowski.

Moniteur Scientifique, du Dr. Quesneville,
January 1874.

Analysis of Potable Waters.—Dr. F. Fischer.—This paper is accompanied by illustrations. The author proposes to determine organic matter by means of perman-

ganate and ammonia by evaporating 500 c.c. almost to dryness with a few drops of hydrochloric acid, and distilling the residue with an alcoholic solution of potassa. The distillate is received in 20 c.c. of a decinormal acid, the excess of acid determined with a decinormal potash solution.

Analysis and the Properties of Blood.—M. Fernand Papillon.—A lengthy paper not adapted for abstraction.

Madder and Artificial Alizarin.—A. Rieu.—The author in a letter to Dr. Quesneville complains that the madder growers of the south of France have undertaken no studies of the respective yield of colouring matter under the influence of different manures; no experiments on the yield of the fifty known varieties of madder; no attempts to improve the strain by selecting seed; no attempts at diminishing the long stay of the plant in the earth; and, in short, no movements calculated to reduce the cost of this precious material.

Polytechnisches Journal von Dr. E. M. Dingler,
Band 210, 1.

Quantitative Determination of Oxide of Iron by means of Hyposulphite of Soda.—J. M. Crafts.

Preparation of Oxalic Acid from Sawdust Bran, and Lignose.—W. Thorn.

Experimental Investigation on Explosives.—Roux and Sarrau.

Purification of Water, and on the Action of Spongy Iron upon Impure Water.—Gustav Bischof.

A New Reagent for Blood, and its use in Forensic Chemistry.—F. L. Sonnenschein.

Preparation of Condensed Milk.—Trommer.

Band 210, 2.

Determination of Oxygen in the Gases Escaping from Lead Chambers.—L. Vogt.

Application of the Refuse of Towns.—F. Fischer.

Report on Coignet's Process for Preparing Animal Matters Destined for the Manufacture of Chemical Manures.—Hervé Magnon.

Preservation of Meat for the Army.—Broxner.

Utilisation of the Sulphuretted Mass.—Moritz Vollmar.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of carbonates of soda and potash, and in apparatus employed therein. Alfred Evans Fletcher, chemist, Liverpool. May 16, 1873.—No. 1786. This consists (1) in passing sulphurous acid, steam, and atmospheric air through common salt to form sulphate of soda; (2) in passing carbonic acid through heated sulphate of soda to form sulphide of sodium and carbonic acid; and (3) in passing the carbonic acid and water or its vapour through the sulphide of sodium to convert it into carbonate of soda. The sulphide of hydrogen finally given off is burnt and again used as sulphurous acid in the first stage of the process. Instead of carbonic oxide, gases or vapours containing hydrogen and carbon or carbonaceous matter may be used. The advantages of this process are that the same sulphur is used over and over again, and that the only materials required are salt and fuel. The apparatus consists of a series of two or more converting chambers connected by passages. The chambers may be heated.

Improvements in preserving stone, wood, and other substances from decay. Robert Austin Plunkett, Warren Point, Down, Ireland. May 16, 1873.—No. 1789. The preserving material is a solution of alum, in the proportion of about 1 pound of alum to 1 gallon of water, applied in a heated state to the surface required to be preserved or protected.

A new or improved compound for the manufacture of lime-cement or plaster, capable also of being used as an artificial fuel. The Reverend Granville Hamilton Forbes, Rector of Broughton, Northamptonshire. May 19, 1873.—No. 1816. The novelty of my invention consists in the mixture of tar with the fowl lime of gas-works. The mixture is burnt, and afterwards reduced to a fine powder. It is then capable of being used as a substitute for common quick-lime in building, or as a substitute for plaster-of-paris. As the compound can be burnt in an ordinary grate, it can be used with other fuel for domestic or other purposes.

Improvements in the manufacture of explosive compounds. Samuel Joseph Mackie, and Camille Alphonse Faure, both of No. 3, Delahay Street, Great George Street, Westminster. May 20, 1873.—No. 1830. This Provisional Specification describes means by which gun-cotton in a fibrous state as when made from cotton waste or skeins may be formed into granules or lumps. Granules formed from gun-cotton which has been reduced to an impalpable powder, and either alone or mixed with other materials, are rendered compact by causing a plunger to descend into a chamber containing a quantity of such granules, the surfaces of the granules having been previously powdered over to prevent their sticking together. The compressed cake of granules so produced is afterwards broken up—also an improved process of drying gun-cotton and other solid explosives—also mixing various substances with gun-cotton and such like.

A new or improved compound for the manufacture of cements or artificial stone, capable also of being used as an artificial fuel. The Reverend Granville Hamilton Forbes, Rector of Broughton, Northamptonshire. May 20, 1873.—No. 1832. The novelty of my invention consists in the mixture of chalk or limestone with the fowl lime of gas-works and with tar for the purpose of making cements or artificial stone. The compound is also capable of being used as an artificial fuel which when sufficiently burnt leaves a valuable residue.

NOTES AND QUERIES.

Lakes.—Will some kind reader please answer the following:—After the precipitation of alumina and colouring matter, are any other ingredients added? Why and how are lakes made into cones, and at what temperature are the cones dried?—M. HOUGHTON.

Carbonising Peat.—The *Scientific American* of March 26 contained an article concerning an invention of Mr. Kidd's for carbonising peat taken from your paper. I would like to get further particulars from parties interested in said apparatus, as to the efficiency, cost, and quality of the peat after treatment. I can control a large peat-bed, and if the peat after the treatment would be suitable for making gas, and to use in furnaces, &c., could find a market close by for same.—G. M. H.

Estimation of Nitrogen.—(Reply to "Student.")—By Dumas's method (combustion with oxide of copper) determine the total nitrogen; and by Varrentrapp and Will's (soda-lime) the nitrogen present as ammonia salts and organic matter: the difference is the nitrogen due to nitrates (details in "Fresenius.")—T.

Estimation of Nitrogen.—(Reply to "Student.")—Take 150 grs. of the sample containing nitrogenous organic matter, sulphate of ammonia, and nitrate of soda. Wash out the sulphate and nitrate with water, diluting the filtrate up to 10 m. grs. measure (leaving the nitrogenous organic matter upon the filter, which may be dried and converted into ammonia with soda-lime). For estimation of the ammonia in the sulphate, take 1 m. grs. measure of the filtrate, which represents 15 grs. of the original sample, introduce into a distilling-flask or retort, and drive off the ammonia with caustic soda (receiving it into normal acid, and estimating as usual). This leaves the nitrate of soda in an alkaline solution ready for converting into ammonia with zinc and iron, or aluminium, at the discretion of the analyst. I have adopted this method some years, and found it work well.—E. HUNTER.

Notes on the Utilisation of Sewage.—(From the "Report of the Main Drainage Committee for 1864," vol. 487).

4728. (To Professor Way.) You stated in your evidence before the Committee on the Sewage of Towns in 1862, that soils contain a power of separating from liquids containing manure all the important elements of the manure, and that the action takes place not by mere filtration, because those dissolved matters would pass through a filter, but by a sort of chemical attraction, between the ingredients of a fertile soil and those of manure?—Yes. At this moment there is a dispute as to what the nature of that action is. Baron Liebig believes that it is a physical action similar to the action of charcoals in removing colour from syrups and things of that kind; my own conviction is, that it is a true chemical action; but it is not at all a settled question.

4729. It is an attraction between the clay and the manurial property of the sewage, is it not?—Yes, in a great measure.

4732. The moment the sewage has sunk into a clay or loamy soil, does not the smell disappear?—Yes.

4733. Is that because those manurial properties have all been abstracted by means of the soil?—Yes.

4740. (To the same.) It is merely a filtration, is it not?—Not exactly a filtration, speaking of sand, apart from vegetation growing on the sand, sand has a peculiar power, which is totally different from the power clay possesses, of which we were speaking just now, but which is still a specific power of its own, absolutely separating salts up to a certain point, from solution. Very old observations have been made by Dr. Hall and other philosophers 200 or 300 years ago, in which the filtration of salt water, for instance, through pots of sand, was found would give water free from salt at all.

4748. Would lime be injurious?—No.

4752. Does lime neutralise those matters that are contained in solution in the sewage, or does it only precipitate those that are in suspension?—That is all, it acts like white of egg in clearing coffee.

4767. (To the same.) There is a report which has been sent to this Committee from Paris, which was made by M. Béhic to the Emperor, that the amount of manure used in 223,000,000 tons, and is worth about £20,000,000 sterling: can you tell us the amount that is used in this kingdom; is it as much as that?—I have not seen that report; does that refer to artificial manures?

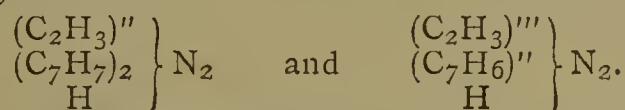
THE CHEMICAL NEWS.

VOL. XXIX. No. 751.

ON THE ACTION OF REDUCING AGENTS UPON BENZONITRANILIDE.*

By CHICHESTER A. BELL, M.B.

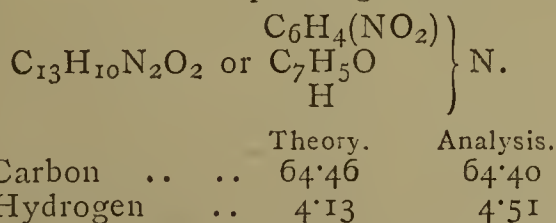
WE know, from the experiments of Prof. Hofmann,† that by the action of phosphorus trichloride on the compounds of the aromatic monamines with formic and benzoic acids and their homologues, a series of diamines is produced, in which groupings of the form C_nH_{2n-1} or $C_{n+6}H_{2n+3}$ take the place of three atoms of hydrogen. Bodies of similar constitution, containing, however, diatomic in addition to triatomic groups, were subsequently obtained in this laboratory by Hobrecker,‡ but in a totally different way, namely, by the reduction of the corresponding nitramides. Thus toluidin and glacial acetic acid with phosphorus trichloride yield ethenyl-ditoluyl-diamin, while the reduction of nitrotoluol-acetamide gives ethenyl-toluylen-diamin.



Hobrecker has experimented with acids of the fatty series only, and it remained to be seen whether similar diamines could be produced with benzoic acid and its homologues.

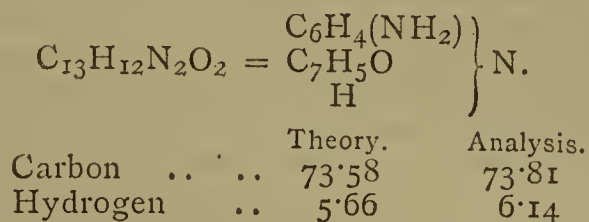
A few combinations of benzoic acid were already known, which might be employed for the solution of this question. A nitrophenyl-benzamide, of which, however, no description is given, had already been prepared by Engelhardt|| by heating nitraniline with benzoyl chloride; and by the action of nitrobenzoyl chloride on aniline, Cahours§ had formed a phenylated nitrobenzamide. It was to be expected that by nitrifying benzanilid an isomer would be produced, and in fact this has been recently described by Hübner and Retschy.¶

The following short notice refers to the compound first observed by Engelhardt. Nitraniline (obtained by reducing dinitrobenzol) was strongly attacked by benzoyl chloride, and from the resulting mixture of benzonitrilide and nitraniline hydrochlorate, the latter was extracted by boiling water, and the remaining amide crystallised, first from hot amyl-alcohol, and subsequently from boiling ethylic alcohol. Benzol and cold spirit dissolve it slightly. After repeated crystallisations, white transparent crystalline plates are obtained, which melt at $152^\circ C$.** By treating these with concentrated acids or alkalies, benzoic acid and nitraniline are reproduced. Analysis gave results corresponding to the formula—



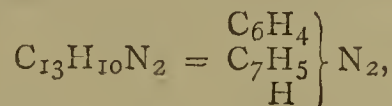
The reduction of the nitramide was accomplished by sulphide of ammonium in alcoholic solution. The purification of the resulting base is attended with difficulty, but is best effected by repeated crystallisation, first from

boiling dilute alcohol, and subsequently from boiling water. In strong alcohol it is freely soluble. In appearance it is similar to the preceding compound, while its fusing-point is $125^\circ C$. Its composition corresponds to the formula—



Thus the nitro-group had simply passed into the amido-group, the benzoyl-group remaining unaffected. Concentrated sulphuric acid reproduces from the combination benzoic acid, probably with simultaneous formation of a salt or a sulpho-acid of phenylen-diamin.

Want of time has prevented me trying whether other stronger reducing agents, such as tin and hydrochloric acid, could effect further reduction and reproduce the oxygen free base—



which Hübner and Retschy have obtained by the complete reduction of nitrobenzanilid.

CHEMISTRY APPLIED TO THE DETECTION OF ADULTERATION.

By ALFRED H. ALLEN, F.C.S.,

Public Analyst for the Borough of Sheffield; Lecturer on Chemistry at the Sheffield School of Medicine.

(Continued from p. 141.)

II. TEA.

UNTIL recently, the methods of detecting the adulteration of tea were in a very unsatisfactory condition, but the subject has been very successfully studied during the past year, and there is now no important adulteration of tea which cannot be detected with proper care.

Tea is commonly divided into the two great classes, of green and black. It is now well proved that the difference in the colour is dependent on the method of preparation, and not on any difference in the nature of the plant. Thus the Darjeeling Tea Company are now preparing as green tea the leaves from the same plants of which they have hitherto manufactured black tea.

The soil on which the tea is grown, the climate, the time at which the leaves are gathered, and the details of the manufacture, all affect the *quality* of the tea, regarded as a commercial article, but they fortunately have but little effect on its composition. On this account, the analyses of genuine teas (when performed in the same way) show a remarkable constancy of composition, and it would be impossible to tell uniformly from the analytical results which teas would command the highest price. This fact is of great importance, for, while any extensive adulteration is rendered apparent from the analysis, there is little danger of mistaking an inferior tea for an adulterated one.

The most valuable constituent of tea, from a dietetic point of view, is undoubtedly the alkaloid *theine*, and it is also the most variable, the amount present in genuine teas ranging from 1.9 to 5.8 per cent (Bell). On this account, its determination is valueless as a criterion of adulteration, though of primary importance when forming an opinion on the *quality* of a tea. No doubt tea-tasters are greatly guided by the amount of theine (ascertained by the taste), though the essential oil, bouquet, tannin, and colour of the infusion also furnish them with valuable information.

Of the commercial value of a tea, of course a tea-taster is the best judge, but the following facts clearly prove that

* From the University Laboratory, Berlin.

† Hofmann, *Monat. Berichte der Berl. Akad.*

‡ Hobrecker, *Berichte der Deutschen Chem. Gesellschaft*, 1872, 920.

|| Engelhardt, *Petersb. Acad. Bull.*, xiii., 357, 379.

§ Cahours, *Ann. Ch. et Phys.* [3], xxiii., 329.

¶ Hübner and Retschy, *Ber. der Deutsch. Chem. Gesell.*, 1873, 798, 1128.

** In the notice recently published by Hübner and Retschy, the fusing-point of the isomeric nitrobenzanilide obtained by treating benzanilide with nitric acid has not been given.

he is not always competent to judge of the presence of certain adulterants, especially exhausted leaves, which merely tend to produce a general weakening of the tea without appreciably altering its bouquet, flavour, &c. Some teas give much darker infusions than others, so that adulteration cannot be recognised by this character alone.

I purchased a pound of black tea at 2s. 6d., and infused a portion of it, using fresh quantities of water, till scarcely any further colour was obtained. The exhausted leaves were re-dried, broken up, and mixed in various proportions with the original tea. The adulterated teas thus obtained were then taken to a professed tea-taster, who liquored them in my presence. He understood that some of the samples contained exhausted leaves, the presence of which was more or less disguised, but I told him that the tea was free from sandy or magnetic matter, foreign leaves, &c.

Conclusion.

No. 1. Contained 30 per cent of exhausted leaves.	Tasted "washed out," no doubt from presence of exhausted leaves.
No. 2. Tea in original condition.	Genuine.
No. 3. Original tea, somewhat crushed.	Mixed with exhausted leaves!
No. 4. Contained 20 per cent exhausted leaves, a little Na_2CO_3 having been added during the re-drying.	Genuine; better tea than No. 3!
No. 5. Contained 20 per cent exhausted leaves, and a little catechu.	A washed-out tea, to which some astringent matter had been added.

Although Nos. 2 and 3 were exactly the same tea, the taster failed to recognise their identity by the taste, and actually classed an adulterated tea as superior in flavour to the broken genuine tea.

The adulterations of tea may be conveniently arranged under four heads—1. Mineral additions used for increasing weight or bulk. 2. Organic additions used for increasing weight or bulk. 3. Adulterants used for imparting fictitious strength. 4. Facings and colouring materials.

1. Mineral Adulterations Used for Increasing Weight or Bulk.

These are—Magnetic matters, such as magnetic iron ore, and lumps and filings of iron; and siliceous matter, as sand, fragments of quartz, &c.

Magnetic Matter is best detected by pounding a known weight of the tea (10 grms.), and placing it on a sheet of smooth paper. A magnet or electro-magnet is applied to the under-side of the paper, and moved laterally, with its poles in contact with the paper. Any magnetic matter is thus readily drawn out and separated from the tea; the use of the magnet should be continued till nothing more follows it. The magnetic matter is next boiled with water for a few minutes to detach adherent organic particles, and the water is then decanted. The residue is next weighed, and then examined under the microscope as an opaque object. If it consists of magnetic oxide or titanate of iron, crystalline facets will probably be apparent, the bulk of the object having a jet-black colour. Occasionally, though very rarely, metallic iron is present. This is distinguished from the minerals by the action of moderately concentrated nitric acid (1·2), which dissolves it, with production of red fumes, but does not affect the native compounds. Metallic iron is also distinguished by its power of precipitating metallic copper when warmed with an acidulated solution of cupric sulphate. The weighing of the matter actually extracted by a magnet is far more satisfactory than the estimation of the iron existing in the tea. Tea naturally contains a small proportion of iron as ferric phosphate, but it only amounts to about 3 per cent of the weight of the ash (calculated as Fe), or to about 0·18 per cent of the whole tea. Of course this is not affected by a magnet, the use of which has the additional advantage of extracting the extraneous iron in the state

in which it naturally exists, and allows of its production in court for the enlightenment of sceptical magistrates.

Caper teas are very frequently adulterated with magnetic matter, sometimes to the extent of 7 or 8 per cent. Many tea-dealers habitually employ the magnet, the use of which is well known to the trade.

Siliceous Matter is readily detected and estimated. Commence by igniting 2 or 3 grms. of the tea in a platinum crucible till all organic matter is consumed, and then weighing the ash. The percentage of this at once indicates the presence or absence of extraneous siliceous matter, provided no magnetic matter is present. The ash of genuine tea varies from 5·24 to 6·00 per cent. Owing to the presence of steatite in the facing of some green teas (especially gunpowder), the ash of these sometimes reaches nearly 8 per cent.

For the estimation of the amount of extraneous silica, the ash should be well boiled with water, and the liquid filtered (the proportion of soluble ash being a valuable criterion of the presence of exhausted leaves). The residue is washed off the filter (or the paper ignited), and boiled with concentrated hydrochloric acid. The extraneous silica, consisting of quartzose particles and insoluble silicates, is left undissolved, and after collection on a filter, washing, and ignition, it may be weighed. The highest recorded amount of ash insoluble in hydrochloric acid occurring in a genuine unfaced tea is 0·82 per cent (Wilson), the average being about 0·30 per cent.

"Caper tea" is the kind most frequently adulterated with siliceous matter, the amount added sometimes reaching 15 or 20 per cent. Of nineteen Canton capers recently examined by Dr. Hassall, the sandy matter varied from 2·09 to 12·83 per cent. I have not met with so high an amount as the latter figure, but 8 and 10 per cent of this adulterant are common.

Frequently the silica exists in the form of quartz fragments of very sensible size. Tea-dealers are well aware of the existence of this adulteration, and of the class of teas most subject to it, and they know that, if present, they will see the sand, &c., at the bottom of the vessel in which the tea is infused.

If desired, the iron can be estimated in the hydrochloric acid solution of the ash by one of the volumetric methods.

2. Organic Adulterations Used for Increasing Weight and Bulk.

These are—Exhausted tea-leaves; and leaves other than those of the tea-plant. The chemical methods for the detection of these adulterants are much the same, but in the latter case we have also the botanical characters of the leaf to rely on, and these are sufficiently definite to enable us to form an opinion quite independently of the analytical results.

Exhausted Tea-Leaves are leaves which have been previously infused in water, and then re-dried, with or without addition of gum or starch.

It is evident that the effect of infusing tea-leaves in water is to extract the greater part of the soluble constituents of the tea, and that the re-dried leaves will have a widely different composition from the original tea.

The two principal constituents extracted from tea by hot water are tannin and gum,—more or less colouring matter, soluble salts, theine, &c., being also dissolved.

Tannin.—Of the soluble constituents, the tannin is by far the most important and constant, but unfortunately until recently the methods of estimating its amount were very unsatisfactory, the whole of the soluble extract, after allowing for the gum, having sometimes been called tannin. I believe I was the first to use a more satisfactory method of determining the tannin in tea, my process being essentially a precipitation by a standard solution of gelatin.* Although the method has since been employed by Hassall, Bell, and other chemists, I have recently been led to abandon it, on account of the tedious nature of the

* Full details of this process will be found in the *Pharmaceutical Journal* for Oct. 25, 1873, and in the "Year-Book of Pharmacy," 1873.

process, the trouble of daily re-setting the gelatin solution, and the occasional anomalous results, which defied all attempts to ascertain their cause.

A very valuable method of estimating tannin has recently been described by Mr. Charles Estcourt,* who seems to have succeeded in determining the relative amount of tannic and gallic acids in tea. But while fully appreciating the scientific value of Mr. Estcourt's results, it seems to me that the separate determination of the tannic and gallic acids is a needless trouble and a complication of the methods of detecting tea adulteration. It also seems probable that a portion of the tannic acid may be converted into gallic acid by the prolonged boiling in water necessary for the thorough exhaustion of the tea, and on this account a method which will estimate the total amount of astringent matter, without distinction of its nature, is preferable to a process that gives merely the amount of tannin, while ignoring the gallic acid.

Black tea differs from green tea in the method of its manufacture, the leaves being allowed to undergo a kind of fermentation when black tea is to be produced. During this fermentation, a portion of the tannin becomes altered, with production of dark-coloured insoluble matters, so that black tea is found to contain a higher percentage of insoluble matter and a lower percentage of tannin than green tea, the sum of the two constituents being moderately constant. By the process of fermentation, the remaining tannin undergoes a curious change, for the tincture of green tea precipitates tincture of ferric chloride bluish-black, like nut-galls, while the tincture of black tea gives a green colour with iron, just as catechu does. If excess of ammonia be added to either coloured liquid, a soluble oxidation-product is formed of a deep red colour. Other oxidising agents may be substituted for the ferric chloride, potassium ferricyanide being the most convenient.

If a solution of tannin or an infusion of tea be treated with a strongly ammoniacal solution of potassium ferricyanide, a deep red liquid is obtained, the depth of colour being a fair indication of the amount of tannin present. This reaction is exceedingly delicate, $\frac{1}{100}$ milligram of tannin being recognisable by it. This is considerably beyond the range of delicacy of the dark colouration produced by iron salts.

When an infusion of tea is precipitated by gelatin in excess, the red colouration is still produced in the filtrate, so that the reaction cannot be used as a colour-test for the end of the precipitation by gelatin, but, if a solution of lead acetate be substituted for the gelatin, an insoluble precipitate of mixed tannate and gallate of lead is thrown down, and no colour is produced in the filtrate on addition of ammoniacal ferricyanide.

Upon these facts, my assistant, Mr. F. W. Fletcher, has founded a process for the estimation of the astringent matters (tannin, &c.) in tea, and we have used it with the greatest success during the past six months in the examination of upwards of a hundred specimens. The details of the process will follow, and I can confidently recommend it as a most rapid and satisfactory method deserving of general use. It is necessary to adhere to the proportions of fluid operated upon, and it must be borne in mind that tannate of lead is not insoluble in free acetic acid unless the solution is sufficiently diluted.

(To be continued.)

VALUATION OF ANTHRACEN.

By T. H. DAVIS.

THE methods at present in use for estimating the amount of anthracen in the crude material for commercial purposes must be acknowledged by all as being far from satisfactory. Of these methods the ones generally used are known as the "alcohol test," and the "bisulphide of carbon test." In the first of these 20 grammes of anthracen

are heated to boiling with 150 c.c. of alcohol of specified strength, allowed to cool to 15° C. and then washed with alcohol of the same strength, until the washings together with the filtrate amount to a stated quantity, usually 400 c.c. The undissolved material is then dried at 100° C. removed from the paper and weighed, the result being multiplied by 5 to obtain the percentage. The melting-point of this undissolved portion is next taken, by heating a small quantity of it enclosed in a glass tube of narrow bore, and drawn out to a point at one end in a bath of sulphuric acid, noting the temperature at which it begins to melt, and also that at which it begins to solidify; the mean between these two readings is taken as the mean melting-point. Now in this method we find that alcohol dissolves a quantity of anthracen, and that it does not dissolve out the chrysen present, and although the weighing of this latter body may to a certain extent make up for the loss of anthracen dissolved by alcohol, yet the result obtained is incorrect as regards the estimation of pure anthracen.

The estimation by CS₂ is somewhat similar to the alcohol method. 10 grammes of crude anthracen are placed in a stoppered bottle, 30 c.c. of CS₂ are poured into it, and the contents well mixed by shaking; the whole must now be set aside at rest for about an hour, at the end of which time the contents of the bottle are poured on to a filter, and the funnel covered with a ground glass plate; 30 c.c. more of CS₂ are now measured and poured into the bottle for the purpose of washing it out, and then poured on the filter. When filtration has ceased the filter is pressed with the fingers, quickly transferred to a screw press, and pressed between blotting paper, so as to get out as far as possible all the CS₂ retained by it; it is then dried at 100°, removed from the paper and weighed, multiplying the result by 10 for percentage. The melting-point of the residue is taken in the same way as in the alcohol method.

This process is to my mind more objectionable than the former, for CS₂ dissolves something like 2 per cent of anthracen and owing to its volatility it is next to impossible for two chemists to prevent evaporation to the same extent, and they therefore disagree in their results. I have known two chemists differ in their results by as much as 4 to 6 per cent in the same sample. When this "bisulphide test" has been used, and in the alcohol method, discrepancies of 2 and 3 per cent frequently occur.

Now as anthracen is an expensive article, and being brought and sold by analysis, the most correct method should be employed, and one in which two or more chemists ought not to disagree more than 0.5 per cent. Such a test I believe to be the one in which anthracen is oxidised to anthrachinon, and weighed as such. For this purpose I take 1 gramme of the well mixed sample, and dissolve it in 40 to 50 cc. of glacial acetic acid, by boiling in a small flask for about 5 or 10 minutes, at the end of which time the liquid becomes quite clear, and of a yellow brown colour. A solution of 10 grms. chromic acid in just sufficient glacial acetic acid and water to dissolve it should be made beforehand, and allowed to stand for a short time, so as to allow the lead present in the chromic acid to settle to the bottom. When quite clear, this solution is poured into the acetic acid solution of anthracen until the chromic acid is in excess, indicated by a drop of it leaving a red spot of chromate of silver when placed on a silver coin; if the flask is now examined a yellowish green precipitate will be found to have made its appearance. The whole should be put by, and when cool diluted with distilled water to about 200 cc.; it should then stand for 6 or 8 hours, when it is filtered through a previously weighed and moistened filter, washed with distilled water till the filtrate is clear, then once or twice with a hot weak solution of soda, and finally with distilled water again until the washings are neutral. The anthrachinon upon the filter should now have a fine yellow silky appearance; it must be dried at 100° C. and weighed till constant, and from this result the percentage of pure anthracen in the sample is the result of an easy calculation after adding 0.01, as directed by E. Lüc for anthrachinon dissolved.

* CHEMICAL NEWS, vol. xxix., p. 109.

As an example I give the result of one estimation carefully made of a sample of crude anthracen, compared with the results by alcohol and bisulphide of carbon:—With alcohol 0.825 sp. gr. = 89 per cent, 34.645 per cent insoluble, and melting-point of 187.5° C. With CS₂, 23.250 per cent insoluble, melting at 198° C.

By oxidation to, and weighing as, anthracen this sample gives as a mean of these determinations 28.358 per cent of *pure anthracen*.

I hope that this article will cause other chemists interested in the valuation of commercial anthracen to publish their views upon this or any other methods which they may have worked out.

ON THE METHODS IN USE FOR DETERMINING THE VALUE OF VEGETABLE AND ANIMAL OILS.*

By J. J. COLEMAN, F.C.S.,
Associate of the Institute of Engineers, Scotland
(Concluded from page 159).

THE next class of oils in descending value, and which we may call Class III., are the olive oils.

They are known in the market under the name of Gallipoli, Sicilian, Spanish, Mogadore, &c., according to the port from which they are shipped; and they vary in colour from a fair yellow to a deep olive green, and in smell from the sweet smell of salad oil to the powerful odour of the dark varieties.

Their commercial value is fixed chiefly by the fact that, possessing most of the good qualities of animal oleins, as far as being non-drying, they are, with the exception of the finest qualities, inferior, on an average, to the animal oleins in colour and smell, and are contaminated by the presence of mucous, sugary, and albuminous substances.

But there is a specific reason why olive oils preserve their value; that is the dictum of the insurance people, who lay down the law that olive oil is the only oil allowed to be used for greasing wool unless an extra premium be paid. This dictum appears to be absurd, and totally devoid of any justification. The fire insurance people (because our grandfathers thought so) say olive oil is the safest oil for mills, but the experiments of Mr. Gellatly and myself contradict this. The result of this state of affairs is that, of the 30,000 tons or so of olive oil annually imported, a very large proportion of it goes to woollen and worsted mills for greasing wool, and that cheap seed oils are sent from this country to the Mediterranean, where they are said to get mixed with, and returned to us as inferior quality of olive oil.

The statement has been frequently made to him by the highest authorities in the trade that this is the case. A reference to the annual circulars of the London brokers reveals the fact that immense quantities of cotton-seed oil are sent annually from this country to the Mediterranean.

The variations in quality of olive oil are, first, those depending upon the way in which it is crushed, a great cause of variation in quality being dependent upon the care with which the olives are plucked, and the length of time that elapses between their being stored in heaps in a half-fermenting state, and the time at which they are crushed—which affects the colour, smell, and appearance of the oil. Secondly, we have the variations dependent upon actual adulteration.

In regard to the first, the market value is influenced to the extent of many pounds per ton (at least £4 or £5), and the only way to arrive at correct judgment is to obtain familiarity with commercial samples; in regard to the second, actual adulteration, our careful consideration is required.

Excepting the particularly fine qualities, the bulk of

olive oils are the cheapest of the so-called commercial non-drying oils, so that we have to look for adulteration with drying oils, fish oils, mineral and resin oils.

Mineral and resin oils must be carefully looked for, because, owing to the dark colour and smell of olive oils, they could easily be overlooked.

It will probably be necessary to refine the oil before looking for mineral oil, which can easily be done; and, if the case is important, an ultimate analysis will be the most satisfactory method of proving presence of the hydrocarbons.

The specific gravity of olive oil is 0.917. Rape oil, a cheaper oil than olive, would make it lighter, and cotton-seed oil heavier, but a proper mixture of the two could be adjusted exactly to the specific gravity of olive, so that we have to depend entirely upon our chemical tests.

The fish oils, then, being proved absent by Calvert's tests or the smell, we have to look for seed oils, and the four tests in practical use are:—

- (1). The well-known nitrous acid, or nitrate of mercury test, which is used and relied upon by the leading merchants, and the full details of which can be found in chemical books.
- (2). The characteristics of the amides produced by liquid ammonia.
- (3). Fehling's tests of the rise of temperature produced by mixing with concentrated sulphuric acid.
- (4). The characteristics of the action of solution of carbonate of potash on the oil.

Olive oil appears to be going out of use for lubricating machinery to a great extent. Its sugary or mucilaginous constituents are liable to ferment and make the oil acid, which, however, can be prevented by refining the oil, bringing it up, however, in cost to that of the animal oleins.

An oil used to adulterate olive oil largely is Lisbon seed oil, which is inferior to olive oil in viscosity, and is presumably like other seed oils detected by the above tests. It closely resembles olive oil in appearance.

It is an important question, how far these inferior oils, such as Lisbon seed oil, cotton-seed oil, sunflower oil, &c., can be used for wool-greasing and Turkey-red dyeing; and until the insurance people remove their restrictions we cannot get accurate knowledge, as the woollen people can only use them surreptitiously or pay higher premiums.

We now pass on to Class IV., rape oils, of which about 20,000 tons are crushed annually in this Kingdom, and about the same quantity is annually imported.

The commercial position of these oils is fixed by their being slightly inferior in non-drying properties to olives, but superior to them in smell and appearance.

Rape oils, in fact, are the border-land between drying and non-drying oils, and, notwithstanding their slight tendency to gum, are used most extensively for engine and machinery lubrication, as well as for burning in lamps.

Two kinds are known in the market—brown rape, or the oil as expressed from the seed, and called sweet oil; and the same, after treatment with sulphuric acid, and steaming, washing, and filtering, and called refined rape oil. These oils have assumed immense commercial importance from the quantity in which they can be produced.

There are several varieties of the genus *Brassica*, from which they are produced, and the oils expressed vary also slightly in gravity. The variety cultivated in France and Belgium gives an oil about 0.912 sp. gr., whilst that cultivated in North Germany gives a sp. gr. of 0.915, and the seed crushed in England, and imported from all parts of the Continent and the East Indies, gives an oil of about 0.914 to 0.916 sp. gr. This difference in specific gravities of rape oils is also accompanied by a similar slight variation in viscosity.

It is important to notice the limits within which the sp. gr. of rape oil varies, because too much importance cannot be attached to this testing of the specific

* Communicated to the Chemical Section of the Philosophical Society of Glasgow.

It should never exceed 0.916; if it does, we may be sure of the presence of one or some of the following oils, viz.:—The fish oils, which are easily detected by the smell or Calvert's tests; or, what is much more probable, other seed oils of a more or less drying character, which may be called fancy seed oils, amongst the chief of which are ground nut, sesame, sunflower, cress-seed, hemp-seed, cotton-seed, Niger-seed, and linseed oils, and possibly cocoa-nut olein, all having a sp. gr. ranging between 0.920 and 0.935. Thus, if rape oil indicates 0.918 sp. gr., it points out to the probable presence of even 50 per cent of these oils, and the smell and colour might be only very slightly affected. These seed oils, with the exception, perhaps, of ground nut, and perhaps cocoa-nut olein, deteriorate rape oil, by adding to its gumming properties. Ground nut oil and cocoa-nut olein being of commercial value equal to rape oil, they are scarcely likely to be present.

But, amongst all these adulterants of rape oil, cotton-seed oil is the most likely to be present. When refined, it is about the same colour as rape oil, and even superior to it in smell. It is a more drying oil than rape oil, but not so drying as linseed oil.

It is produced to the extent of some 17,000 tons annually in this country, and it is very puzzling to account for where it goes to, as the public scarcely ever hear of it under its proper name. Much, no doubt, is consumed by soap makers, for which it does very well. Its market value is always considerably under that of rape oils, and even sometimes below that of linseed or the drying oil proper.

The ease with which cotton-seed oil can be detected in lard or tallow olein and in olive oil has been made evident. It is equally easy to detect in rape oil.

- (1). It increases the specific gravity (mineral and resin oils being proved absent).
- (2). It raises the freezing-point of rape oil, pure rape oil being perfectly liquid at 32° F.

The other tests applicable are those for estimating the drying properties of the oil or its tendency to gum, either by the blotting-paper test or by small capsules of the oil exposed to 200° F.

Finally, the commercial value of refined rape oil is about £2 per ton more than that of unrefined.

Class V. is represented by linseed oil, the drying oil proper, of sp. gr. 0.937 at 60° F., and of which about 40,000 tons annually are crushed in this country.

From its dark colour, mineral and resin oil must be carefully looked for, and in their absence fish oils are easily detected by smell or Calvert's tests.

By far the most likely adulterants will be cotton-seed or Niger seed oils, which may be recognised.

- (1). By decreasing the specific gravity.
- (2). Materially raising the freezing-point.
- (3). Decreasing the drying properties, which can be proved as before indicated.

Class VI., the fish oils, have a commercial value inferior to the other oils, principally because of their "stink." They are generally considered non-drying oils, so that, if free from smell, they might be applied to most purposes for which other oils are used. At present their use is limited to soap-making, especially for soft soap, greasing leather, greasing jute before spinning (for which several thousand tons annually are consumed), burning in coal-pits, and other purposes where smell is not of much consequence. Rape oil and paraffin oil have almost superseded them for household lamps.

Their price is to some extent regulated by their odour, and partly by their colour and viscosity. The thicker kinds, Northern whale and cod oil, being best adapted for eather, whilst the thinner kinds, as seal oil, are preferred or burning purposes.

The fish oils are not much liable to adulteration, because there are no oils, as a rule, sufficiently cheap for the purpose, except occasionally cotton-seed oil, and perhaps

very seldom linseed oil, which would not injure them for soap-making, but would spoil them for burning or lubricating.

They, however, may be mixed with each other, some varieties, as porpoise oil, herring oil, and East Indian fish oil, being much cheaper than others. The points, then, to observe are:—

- (1). Looking for mineral and resin oil.
- (2). Examining the drying properties of the sample.
- (3). Examining the viscosity.

The subject having been considered from the chemist's point of view, rather than the engineer's, it may be remarked that a paper by the author read before the Institute of Engineers of Scotland, November, 1872, deals with the increasing applications of mineral oil on account of economy, more particularly in reference to giving it sufficient viscosity to enable it to be used for heavy machinery.

The author has to express his acknowledgments to Mr. W. H. Hatcher and other friends for information connected with this paper.

ON THE NATURE OF THE CHEMICAL ELEMENTS.*

By M. BERTHELOT.

I THINK the hypothesis of a progressive decomposition of all substances through increasing temperature, bringing first compound substances to the elements known to chemists, and then again to yet simpler elements, is to be enunciated with reserve.

Simple substances, as we know them, have certain positive characters not belonging to compounds; such are the relation between specific heat of a substance, its gaseous density, and its atomic weight, relations independent of the temperature.

Simple gases, with the same volume and pressure, all absorb nearly the same quantity of heat, to be raised one degree, which seems to me to answer to a like increase of *vis viva*. With the same volume their absolute weights are, moreover, proportional to their atomic weights. Hence, a relation between the atomic weights and the specific heats of the elements; it is Dulong and Petit's law, discovered, as we know, by a study of solid substances.

Now these elements tend to retain their specific heat in combinations. It was long since remarked that the product of the specific heat of a solid compound substance by its atomic weight, that is to say, its atomic specific heat, scarcely differed from the sum of the analogous products in the case of its elements, a relation fully verified by the researches of Regnault, Neumann, and Kopp. If we suppose, with Dulong, that the atoms of all the elements have the same specific heat, we see that the atomic specific heat of a solid compound body will be equal to this common value multiplied by the number of atoms forming the compound.

The same relations are found to exist in the case of compound gases formed without condensation, such as bioxide of nitrogen, chlorhydric acid, and carbonous oxide. More than this, M. Clausius, and most physicists who have been occupied with the mechanical theory of heat, suppose that this relation must be general for the specific heats of compound gases taken at constant volume and in the state of perfect gas.

Without going beyond the domain of experience, however, it may be remarked, on the one hand, that the atomic weights of compound gases, determined by purely chemical considerations, occupy, in general, the same gaseous volume; and, on the other, that the quantity of heat

* *Apropos* of a communication from Mr. Lockyer.

necessary at constant pressure to elevate 1 degree, a certain volume of a gas which is compound and formed with condensation, is, without exception, superior to the quantity of heat absorbed by the same volume of a simple gas under the same pressure; the difference is greater the more complex the constitution of the gas.

This being allowed, it is easy to assign the characters which would be presented by one of the substances now supposed simple, if it were really formed by the union of several others of our elements, or by the condensation of several atoms of the same element, that combination or condensation being supposed comparable to those which give rise to actual compound substances.

If the case were that of one of our gaseous substances, wrongly thought elementary, it should be formed without condensation by the union of its two hypothetical elements; for the compound gases formed with condensation are the only ones that present the same specific heat as simple gases with the same volume. All other gases have a specific heat, much greater and tending towards the sum of those of their elements. But, on the other hand, the atomic weight of the pretended element would be equal to the mean of the atomic weights of the components, and not to their sum. Whence it follows that their cannot exist an element such that its atomic weight is formed by the union of a certain number of atoms identical with those of another element in the manner of our actually known compounds; there is no polymeric element playing the same chemical rôle as the non-condensed element whence it is derived; that is, in the sense of polymeric compounds of organic chemistry, the atomic weight of which is the sum of the atomic weights of their components.

To take an example:—We may compare a series of elements, the atomic weights of which are nearly multiples one of another. Such are—Hydrogen, with atomic weight = 1; oxygen, about 16; nitrogen, 14. Now, if oxygen resulted from the association of 16 atoms of hydrogen, just as bioxide of nitrogen results from the association of 1 volume of nitrogen and 1 volume of oxygen, it ought to occupy a volume nearly sixteen times as large; otherwise the specific heat of hydrogen, as measured by M. Regnault, would not satisfy the laws of specific heats of compound bodies. Similarly, nitrogen should occupy a volume fourteen times as large. We thus see that the laws of gaseous specific heats, determined by experiment, establish a profound difference between our actual elements and their known or probable combinations: this difference is independent of temperature.

The same differences exist in the case of solid compound substances compared with solid elements. Let there be a series of similar elements, multiples of the same unit, such as the thionic elements:—

Sulphur, the atomic weight of which is equal to	$16 \times 2 =$	32
Selenium, about	"	$16 \times 5 =$ 80
Tellurium	"	$16 \times 8 =$ 128

The atomic weights of these elements are absolutely defined,—by their gaseous densities, taken at a temperature sufficiently high; by their combinations with the same group of elements, such as hydrogen and the metals. In particular, they form with hydrogen—

Sulphydric acid	S_2H_2
Selenhydric acid	Se_2H_2
Tellurhydric acid	Te_2H_2

At first sight it appears that we may compare this series of elements with a series of carbides of hydrogen, variously condensed, but having equal chemical properties. Such are—

Ethylen, the atomic weight of which is equal to	$14 \times 2 =$	28
Amylen	"	$14 \times 5 =$ 70
Caprylen	"	$14 \times 8 =$ 112
Ethalen	"	$14 \times 16 =$ 224

The atomic weights of these carbides are absolutely

defined,—from the physical point of view by their gaseous density; from the chemical, by their combination with the same group of elements, such as hydrogen, chlorine, &c.

Between the series of thionic elements and the series of ethylenic carbides the parallelism is evidently very close; and an opinion held by good authorities seeks, on these analogies, to connect certain series of simple substances with series of compounds.

But this relation only extends to the specific heats. In fact, the specific heats of sulphur, selenium, tellurium, taken at unit weight, are in inverse ratio of their atomic weights; that is to say, that their atomic specific heats have the same value, conformably to Dulong's law.

On the other hand, the specific heats of the polymeric carbides cited are nearly the same at unit weight, according to the determinations of them known; that is to say, that their atomic specific heats are multiples one of another, being proportional to their atomic weights.

Between the compound bodies that we know and their polymers there is, then, this general relation—that the atomic specific heat of a polymer is nearly a multiple of that of the body not condensed.

On the other hand, the atomic specific heat remains constant for the various elements, the atomic weights of which are multiples one of another. The same difficulties exist for the hypothesis of a simple substance, the atomic weight of which is the sum of the atomic weights of two others.

There is, therefore, between the physical properties of the elements and those of their compounds, a singular opposition; and it is the more important, that the notion of specific heat is a translation of general molecular work, by which all substances are maintained in equilibrium of temperature with one another. This opposition does not at all prove (and I wish not to be misunderstood on this point) the theoretical impossibility of decomposing our actual elements; but it better defines the conditions of the problem, and leads us to think that the decomposition of our simple substances, if it may occur, must be accompanied by phenomena of quite a different order from those which have hitherto determined the destruction of our compound substances.

NOTICES OF BOOKS.

Questions in Chemistry and Natural Philosophy. Given at the Matriculation Examination of the University of London from the year 1864 to June, 1873. Classified according to the syllabus of subjects of examination, by C. J. WOODWARD, B.Sc. London: Simpkin, Marshall, and Co. Birmingham: Cornish Brothers.

So much trash has been recently published in the form of handbooks, text-books, and other compilations especially intended for the preparation of candidates for examinations, that we are disposed to look rather suspiciously on anything that includes in its title or sub-title any reference to any kind of examination whatever. There is but one safe method of qualifying for such examinations, that is, to study the subject fairly and conscientiously, and scrupulously avoid all the dodges and dishonesty of any and every system of cramming. The student may safely take it for granted that any elementary treatise on any scientific subject which is published for the avowed purpose of preparing for any particular examination, or for examinations in general, is a bad book, and just one of those which he should most carefully avoid.

These remarks apply to the *study* of the subject itself. Still, however, it is quite possible that a given student with a fair amount of sound knowledge may take a lower place in an examination than another student who has rather less knowledge; and this difference may arise from the fact that the first has neglected the legitimate preparation by which he may acquire the art of displaying to

best advantage in an examination paper the knowledge he does possess. It is perfectly legitimate and most desirable that, *after* having sufficiently mastered the subject of his studies, he should specially prepare himself for coolly and effectively undergoing the ordeal of an examination upon it. How should this be done? The answer is simple enough. Like every other kind of skill, the art of working examination papers can only be attained by actual practice. The little book before us is admirably and most legitimately adapted to the purpose of affording the student the materials for self-examination, and for exercise in the attainment of this art by those who have already passed through the indispensable previous preparation of conscientious study.

Even to those who are studying the elements of chemistry and natural philosophy, for their own sakes such a series of questions are very valuable, especially where an intelligent teacher can be obtained who will go through the students' answers and make the errors they may contain the subjects of careful lessons. By this means some ugly gaps in the student's knowledge may become visible and be filled up, and serious mistakes that might be made thereafter will be thus prevented.

As Mr. Woodward says, "it is a fair inference that if a candidate can, *without help*, work all, or nearly all, the questions that have been given for the last ten years, he will be likely to pass the examination of the eleventh year." If he cannot work these questions, let him follow Mr. Woodward's advice, and "go over the subject a second or third time, until the questions can all be worked satisfactorily." This is especially necessary to those unfortunate students who have been deluded by examination cram-books, and have sought to qualify themselves for scientific examinations by learning science by rote.

These questions are published by permission, and we strongly recommend every candidate for the Matriculation Examinations of the London University, and for the Oxford Middle Class and other examinations, to obtain and use them in accordance with Mr. Woodward's directions.

A Handbook of Practical Telegraphy. By R. S. CULLEY, Memb. Inst. C.E., Engineer-in-Chief of Telegraphs to the Post Office. Adopted by the Post Office and by the Department of Telegraphs in India. Sixth edition, revised and enlarged. London: Longmans, Green, Reader, and Dyer. 1874.

THIS edition is a handsome volume, embellished with 144 well-executed woodcuts of descriptive illustrations, and several full-page designs of instruments in use, showing the methods of connecting them up to line. There are also six large folding plates. Mr. Culley has adopted an excellent plan of using initial type for whatever statement is important, so that, as the reader's eye roams over the pages in quest of facts, his attention is at once directed to the salient points of each chapter. The volume contains an exceedingly clear description of the new method of telegraphing on the "duplex system," whereby two stations can signal their messages to each other at the same time. The work is in all respects a handbook of practical telegraphy.

Traité des Matières Colorantes Artificielles Dérivées du Goudron de Houille. Par P. BOLLEY and E. KOPP. Traduit de l'allemand et augmenté des travaux les plus récents par le Dr. L. GAUTIER. Paris: F. Savy.

THIS work, like the "*Traité des Dérivés de la Houille*" of Girard and De Laire, treats of the so-called coal-tar colours practically and theoretically. Nevertheless, the two works differ in their plan. Bolley and Kopp enter at length into the preparation of artificial alizarin, of corallin, rosolic acid, resorcin, gallein, and a variety of other colours, whilst Girard and De Laire confine themselves more

strictly to the aniline dyes, properly so-called. Hence the library of every tinctorial chemist should contain both. Bolley and Kopp commence with an account of coal-tar and its rectification, and consider, in successive chapters, phenol, its homologues and derivatives; benzol, its homologues and derivatives, including aniline, toluidin, xyli-din, cumidin, and the manufacture of their red, blue, violet, green, yellow, black, and grey compounds; naphthalin and its derivatives; anthracen and its derivatives; and, finally, the colouring matters obtained from phenols. An Appendix describes artificial colouring of different origins, such as cyanin, the aloes colours, rufigallic acid, and murexide. There is an elaborate bibliography and a good index, in which the work of Girard and De Laire is wanting. The student will find here many valuable indications concerning fields for future research, and the practical man will meet with not a few hints of unquestionable importance.

The appearance of such a work so soon after that of Girard and De Laire is a new proof, if proof were still needed, of the lively interest in the progress of applied chemistry felt on the Continent. Meantime, what are we doing? Instead of developing native talent, we are more and more placing the management of our chemical manufactures in the hands of foreigners, just as the Romans, in their decline, filled up the ranks of their legions with stranger mercenaries. *Absit omen!*

CORRESPONDENCE.

ADULTERATIONS OF FOOD.

To the Editor of the Chemical News.

SIR,—Referring to the last paragraph in your notice of Mr. Atcherley's book, I trust you will allow me to state that, as I am not—so far as I know—as yet a fit inmate for a lunatic asylum, I never gave out the statement that brandy sinks in water. What I did state, some three years ago, was that a liquid called *jerupigia*, manufactured from elder, &c., had been long used for giving colour and body to inferior port, and that if floated with certain precautions upon water, wine so "ameliorated" would sink and colour the water more rapidly than the genuine article. This test was none of mine, but one taught me by a Portuguese wine-factor as in common use by men in his trade, and I believe I so stated at the time.—I am, &c.,

JOHN MUTER.

231 and 325, Kennington Road, S.E.
April 13, 1874.

ADULTERATIONS OF FOOD.

To the Editor of the Chemical News.

SIR,—In your article on Dr. Atcherley's work on food adulteration two considerable errors have escaped notice. (1) On page 13 a definition of beer is given, the author stating that malt and hops are the only substances permitted by law. Since the repeal of the hop duty any bitter may be used instead of hops, and, as is well known, in most large breweries during scarce hop seasons various bitters are used to replace hops. This with good effect; since by the taste the difference cannot be perceived, whilst the bitter used is quite as wholesome as that of the hop. The Licensing Act schedules a number of substances *not* to be used. (2) The illustrations at the end of Dr. Atcherley's book, representing tea-leaves and the tea-plant, may certainly, for aught I know, represent some leaves and plant, but are as certainly totally unlike those of the tea-plant.—I am, &c.,

C. ESTCOURT, F.C.S.

Manchester, April 11, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, February 23, 1874.

Undulatory Movement of a Train of Waggon's due to Shock.—M. Resal.

Acid Waters Arising in the Volcanoes of the Cordilleras.—(Continued.)—M. Boussingault.

Determination of the Densities of Vapours.—M. Sainte-Claire Deville.—The author gives reasons for preferring Gay-Lussac's method to that described by M. Croullebois.

Process Devised by M. Dulong for Finding the Density of Vapours.—M. Dumas.—M. Dulong used a vessel of known capacity immersed in a bath of known temperature. The vessel contained a very small quantity of the substance experimented on, and communicated by a capillary tube with a barometric tube immersed in mercury.

Observations with Reference to the Late Communication from M. Clausius on the Equation

$$\int \frac{dQ}{T} = 0. \text{—M. Ledieu.}$$

Memoir on the Swimming-Bladder, with regard to Station and Locomotion of the Fish.—M. Moreau.—Of changes in volume of fish some are passive (from external pressure), others active (through efforts of the fish). The author discusses passive variations of the perch, whose bladder is quite closed, having no aerial passage. In one experiment, the fish being captive, he proved, by means of special apparatus, that its volume varies directly as the pressure it is subject to; and it varies sensibly, not only with great, but with very slight changes of pressure. It further appears, from a tracing, that the perch did not act on its bladder in movements executed by it freely (rising and sinking) in the containing vessel. The results from other kinds of fish will be given later.

Observations on a Recent Memoir of M. Helmholtz on Aërial Navigation.—M. de Fonvielle.—M. Helmholtz has sought to determine the energy of the motor forces necessary in a steam balloon inflated with pure hydrogen in order to give it a velocity in the face of a slight breeze. He concludes that to give the aërostat a velocity of 30 kilometres per hour, there must be expended about 100 per cent of the motor force necessary to obtain a velocity of 21 kilometres per hour in a large German steamer (on which observations were made); but the volume of the aërostat must be forty-two times the displacement of the vessel. The chief difficulties, according to M. Helmholtz, are the great size which the aërostat must have, and the weight of the motor screws. M. de Fonvielle remarks that the rapid rupture of thermal equilibrium by action of solar rays, the sudden surcharges through fall of rain, friction from currents, electric phenomena, and many other obstacles, which M. Helmholtz has left out of account, complicate the case. His reasoning would only hold good if the moving bodies had the same geometric form, and merely differed in scale of construction. In the ship he only considers the immersed part, and as the aërostat is completely immersed, his reasoning would only be applicable if it were shown that the dynamic conditions of movement, force, velocity, and friction were the same where the large steam vessel moved under water altogether. Now it seems demonstrated that, other things equal, the movement would be much more easy under water, and the velocity would be greater for the same quantity of force developed, supposing such a vessel could be made. Some fish go faster under

water than the most powerful steamers, though their organic heat, which is the source of their dynamic force, is very small. M. Helmholtz's conclusions, then, based on a study of superficial movement, are much too high, though it may be impossible to say how much. Again, he neglects the retardative effects of a partial vacuum behind the large aërostat, and the condensation in front. Some further objections are urged.

Permanent Magnetism of Steel.—M. Bouty.—Consider two bodies, A and B, subjected to the same inductive force but invariably conducted with one another. After cessation of the force the body A remains subject to the action of B, and retains, besides the residual magnetic moment which would remain in it after removal of A, a moment of the same or of contrary direction, produced by influence of B, and which is permanent only so long as the connection of A and B subsists. This magnetic excess may be called the *sub-permanent magnetic moment*. In the experiment of a bundle, ruptured parallel to the axis, the sub-permanent magnetism is in contrary direction to the permanent magnetism. It is of the same direction in the case of a cylindrical needle ruptured by a plane perpendicular to its axis, and of which the two fragments are separated and united end to end. This agrees with experiment.

New Apparatus for Registering the Direction of Clouds.—M. de Parville.

Distribution and Determination of Thallium.—Dr. T. L. Phipson.—The author considers that thallium is more generally distributed than is commonly supposed. He has detected it especially in metallic cadmium, in Norwegian and Spanish pyrites, and in many other ores and industrial products. The procedure for its separation is simple. It must always be determined as protoxide, but in the ordinary course of a quantitative analysis, thallium, if present in the body under examination, is always peroxidised and escapes along with the iron in whatever form the latter is separated. The author dissolves the ore in *aqua regia*, dilutes with water, and precipitates with sulphuretted hydrogen. The filtrate is brought to a boil, air being excluded as far as possible. It is then treated with carbonate of soda in slight excess, and filtered rapidly while still hot. From the filtrate sulphuret of ammonium precipitates all the thallium as sulphuret.

Presence of Metallic Silver in Galena.—Dr. T. L. Phipson.—The author found a sample of galena interpenetrated with slender filaments of metallic silver. The ore was obtained from the Phoenix Silver-Lead Mine, in Cornwall. Metallic silver was observed only in specimens from the exterior parts of the vein. Within, where the galena was mixed with carbonate of lead in fine crystals, no silver was found.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 47, 1873.

Bloch's Feculometer.—This apparatus, for determining the amount of water in commercial samples of starch, has been already noticed in the CHEMICAL NEWS.

Disorganisation of Cotton, and of Vegetable Fibres by the Action of Alkalies and Oxidising Agents.—M. Jeanmaire.—Vegetable tissues saturated with chromic acid, with chromate of potash, and sulphuric acid, or with permanganate of potash, and washed after the reduction of the oxidising body has taken place, though presenting then no apparent alteration, are found to be seriously weakened when treated with any alkali. It is not essential that the oxidising agent should be acid in order to produce this reaction. The same result takes place with the alkaline ferricyanides. Chromate of baryta or of lead fixed upon a fabric, and then passed through sulphuric or oxalic acid, acts similarly. In the reaction with chromic acid not a trace remains upon the cotton. Chromic acid appears to oxidise or dehydrogenise the

fibre, forming a new body, which is disorganised under the influence of an alkali. These reactions enable us to decide if a white or a yellow upon a vat-blue ground has been produced by means of a resist, or by a chromic discharge. In the latter case, the fabric when steeped in an alkali, is not affected in its white parts. Red prussiate discharges have the advantage of remaining unaffected in similar circumstances, owing to the comparatively slow action of the ferrid-cyanides.

Bread Containing Liebig's Extract, and Gluten Bread for Diabetic Patients.

Drying of Tissues by means of Steam.—M. Bastaert.—Superheated steam is recommended instead of heated air for drying textile fabrics, and is said to leave them in a more supple condition.

New Apparatus for Lighting with Gasoline.—Langsdorff and Meyer.—This paper should have been accompanied with an illustration.

Archives des Sciences Physiques et Naturelles,
December 15, 1873.

Elliptical Polarisation of Light, and its Relations to the Superficial Colours of Bodies.—M. Wiedemann. (Extract).—The author finds that superficial colours change considerably with the nature of the media in contact with which they are produced, and therefore the data hitherto obtained only are limited to the case of air. From his own and other researches M. Wiedemann formulates several conclusions, among which are these:—Metalliform bodies behave in their transparent parts, as regards retardation of light with various angles of incidence, like transparent bodies, and in opaque portions like metals. Colours which are most strongly reflected present, generally, the most intense elliptic polarisation (where the reflection is in air or *in vacuo*). The principal angles of incidence undergo the most rapid modifications for wave-lengths corresponding nearly to the bands of absorption. In opaque bodies the tangent of the principal angle of incidence is equal to the index of refraction, and hence it is in the neighbourhood of the bands of absorption that the indices of refraction increase or diminish most rapidly. The calculation of the indices of refraction according to Brewster's law, gives, in the case of solid fuchsine a very pronounced anomalous dispersion (the differences between the indices of refraction of the line C and F is about thirty-one times greater than in sulphide of carbon). From these results M. Wiedemann proceeds to explain some other peculiarities of substances with superficial colours. His work establishes a connection between the phenomena of these substances on the one hand, and the principal angle of incidence and the proportion of the principal amplitude on the other. The problem of substances with superficial colours is reduced to a question of elliptical polarisation, and the connection of this with absorption.

Meteorological Congress at Vienna in 1873.

Journal de Physique, November, 1873.

Equality of Fundamental Numerical Constants of Optics and Electricity.—M. Potier.—An account of Maxwell's treatment of this subject in his recent work on electricity and magnetism.

Articulated Beam with Rectilinear Movement.—M. Peaucellier.—In steam navigation it is desirable to have engines with short beam and yet a considerable piston course, and the instrument here described meets these conditions.

Loss of Electricity by Air.—M. Brion.—The author cites some experiments by M. Charault, made several years ago, as dissipating any doubt (still suggested) as to the generality of Coulomb's law.

Note on the Model of a Vernier.—M. Mannheim.

Reflection Galvanometer.—M. Raynaud.—First part of an instructive paper.

Repertorium fur Experimental Physik, band ix., heft 5.

Determination of the Temperature Coefficients of Steel Magnets.—M. Wild.—The author shows the importance of this determination in magnetic measurements; compares three different methods of making it; the first depending on oscillations, the second on deflection, and the third (preferred as the best) on the change of position of equilibrium of a bifilar-suspended magnet with differences of temperature. M. Wild asserts that the present condition of our magnetic instruments, and of our knowledge of the laws of magnetism, is not sufficient for determining the horizontal intensity of terrestrial magnetism with a certainty of ± 0.0001 .

Reply to the Remarks of M. Bredichin on the Field of Vision and Magnification of Optical Instruments.—M. Lubimoff.

Fall-myographion.—M. Jendrassik.—In this instrument, described with considerable details and illustration, the principle of Atwood's machine is introduced in the measurement of phenomena of muscular contraction.

Regulator for Electric Currents.—M. Mascart.

Sound-Decomposing Apparatus for Schematic Explanation of Sound Analysis by the Ear.—M. Jendrassik.

Monatsberichte der Koniglich Preussischen Akademie der Wissenschaften zu Berlin, September and October, 1873.

Limits of Capability of the Microscope.—M. Helmholtz.

Reduction of the Annual Temperature-Curve, to the Conditions Determining it. (Second paper.)—M. Dove.—The author discusses observations of summer heat, the average, and deviations from it; and one fact elicited is the progressive (unsimultaneous) character of these deviations over a large extent of surface.

Unsere Zeit., January 1, 1874.

Plutonism and Vulcanism of the last few years in Germany.—Dr. Karl Müller.—An instructive paper on recent earthquake phenomena and their cause.

Liebig's Annalen der Chemie und Pharmacie.
January 19, 1874.

Nitro-Compounds of the Fatty Series.—Victor Meyer.—A very lengthy paper, announced as the commencement of a series. The author begins with nitrous ether and nitro-compounds, describing experiments on their formation. He next enters upon the action of tin and hydrochloric acid upon amylene dinitroxide, the constitution of hyponitric and nitric acids, the specific volume of nitrous ether, and experiments on the introduction of nitrogen-oxygen radicals into fatty bodies. In the second section the author treats of the nitrated hydrocarbons of the fatty series; nitroethan; action of iron and acetic acid upon nitroethan; action of alkalies upon nitroethan; the metallic derivatives of nitroethan; nitromethan; normal nitropropan; pseudo-nitropropan; nitropentan; action of iodethyl upon nitrite of silver; iodethyl and sulphocyanide of silver; mono-brom-nitroethan; dibrom-nitroethan; action of fuming sulphuric acid upon nitroethan; action of common sulphuric acid.

Certain Derivatives of Solid Dibrom-benzol.—V. Meyer and C. Wurster.—An examination of the action of ammonia upon nitro-dibrom-benzol. The authors did not succeed in converting dibrom-benzol into phenylen-diamin, but have obtained phenylen-diamin from brom-nitro-amido-benzol.

Investigation into the Constitution of Certain Chloral Compounds.—V. Meyer and L. Dalk.—The

authors have examined the action of chloracetyl upon chloral hydrate and upon chloral; the action of chloracetyl upon chloral-alcoholate; that of anhydrous acetic acid upon chloral; that of glacial acetic acid upon chloral; and the behaviour of chloral and trimethylamin.

Preparation and Examination of Crystalline Xylol (Para-Dimethyl-Benzol).—Paul Jannasch.—Pure para-xylol melts at 15° , and boils at 136° to 137° . It is composed of—

Carbon	90.56
Hydrogen	9.43

99.99

As by-product the author obtained crystalline ditolyl. Crystalline xylol, when oxidised with dilute nitric acid, yields para-toluic acid, fusing at 173° . The authors also obtained mono-brom-para-xylol by the reaction of 2 equivalents of bromine to 1 of para-xylol.

Preparation of Para-Brom-Toluic Acid from Crystalline Brom-Xylol.—The authors prepared this acid from crystalline brom-xylol by oxidation with chromic acid dissolved in glacial acetic acid, and examined its barium and calcium salts.

Mutual Behaviour of Oxygen and Water.—Em. Schœne.—The author concludes from a series of carefully conducted experiments that—(1) Ozone is partially destroyed by passing through water. If dry, ozonised oxygen is simply collected over water, the ozone present is diminished by about one-fourth. If passed through water for a longer time the loss of ozone is greater. The loss of ozone is the more considerable the longer the gas is in contact with the water, and the greater the surface exposed. (2) Ozone is absorbed by water in a considerable degree, even at the ordinary temperature of the atmosphere. (3) On passing dry ozonised oxygen through water much more ozone disappears than is absorbed by the water. The decrease of the proportion of ozone is, therefore, only very slightly determined by absorption, but must be considered as a consequence of the destructive action of water. (4) Ozone does not convert water into peroxide of hydrogen. As regards the loss of ozone in ozonised oxygen gas on standing for a longer or shorter time in contact with water, the author concludes—(1) If ozonised oxygen is left in contact with water, the ozone is gradually converted into ordinary oxygen. In three days the original proportion of ozone is reduced to one-half, and in fifteen days mere traces of ozone remain. (2) The transformation of ozone into oxygen in contact with water and at common temperatures is attended with an increase of bulk.

Formation of Metallic Sulphides by the Sulphides of Ammonium and of the Alkalies.—E. Priwoznik.—The oxides of copper in contact with polysulphides of ammonium are changed into ammonio-persulphide of copper, and subsequently, if there is free access of air, into sulphide of copper. Oxide and peroxide of lead are changed by sulphide of ammonium, at common temperatures, into crystalline sulphide of lead. Under similar circumstances peroxide of thallium yields immediately amorphous sulphide of thallium. Oxide of cadmium, both the crystalline blue-black and the brown variety, are converted by polysulphide of ammonium almost completely into sulphide of cadmium slowly at common temperatures, but more rapidly with the aid of heat. Protoxide of manganese yielded with yellow sulphide of ammonium at 100° sulphide of manganese of a flesh-red colour. Hydrated peroxide of manganese yields with the above sulphide a flesh-red sulphide, with the evolution of heat. The native peroxide (pyrolusite) yields a green sulphide. Oxide of iron and chromic oxide are not perceptibly affected by this reagent.

Peroxide of Chrome.—Hugo Schiff.—Remarks on the author's mode of obtaining this compound, viz., by evaporating a mixture of bichromate of potash and oxalic acid with nitric acid.

Benzylic Acid and Diphenyl-acetic Acid.—R. Symons and Th. Zincke.—A lengthy paper not adapted for abstraction.

Simple Apparatus for Filtering at an Elevated Temperature.—Dr. A. Horvath.—A soft leaden tube is wound in a spiral round the funnel. One end of it is then connected with a flask or retort full of water placed over a source of heat. The current of steam passing through the spiral maintains a high temperature in the funnel.

Reimann's Farber Zeitung, No. 5, 1874.

This number contains an essay on shoddy; a paper on certain varieties of blue vats; and a notice on dyeing Turkey reds with artificial alizarin, by Armand Mueller. The author remarks that goods dyed with artificial alizarin are often unequal and dull. The fault is rarely to be found in the alizarin, and then depends on the weakness of the paste or on the presence of sulphuric acid. Alizarin of this kind was obtained from an English establishment. Another cause of failure is the speed of the dyeing process. If the goods are well mordanted, and the beck is at a boil the colour is absorbed so eagerly that it is spotty and dull, being merely smeared upon the surface. If tannin is used after aluming the goods, take a fine yellowish red, but if too little tannin is employed, and especially if alum or nitrate of alumina is also deficient, the tone is bluish, which is very objectionable. The chief fault in mordanting is the use of too strong a caustic soda. In this case a pale yellowish rose shade is obtained. Deficiency of cow-dung, and the use of an oil not sufficiently rancid, likewise give a blue tone to the cloth. If the goods are dried at too low a temperature, and not sufficiently exposed to the air after each treatment with oil, the red will be meagre. The air must be very damp, not cold, and should contain ozone. The pieces must be hung in a light, but not sunny place. There are further instructions for a Havanna-brown on silk, a pansy on garments with cotton warps, and for finishing silks.

Artificial Alizarin in Printing.—Hitherto artificial alizarin has been chiefly used as a steam colour, but it can also be employed like garancin and fleurs de garance. To prepare the dye-beck, chalk to the extent of 1 per cent of the alizarin paste to be employed is stirred into the beck, which is heated to 70° R. The goods, previously printed with the mordants, aged, dunged, and washed, are unwound into the beck, and heated quickly to a boil. The dyeing is complete in ten minutes. The alizarin in the spent bath in combination with the excess of chalk is precipitated with hydrochloric acid, and recovered from the precipitate thus formed. The dyed pieces are washed in warm and cold water, and then three times, using each time $\frac{1}{2}$ lb. soap per piece; the two first soap-baths at 50° and the third at 70° R. They are then placed in a weak solution of chloride of lime for half an hour at 25° R., washed again, dried, and finished.

Bulletin de l'Academie Royale des Sciences, des Lettres, des Beaux-Arts de Belgique, Nos. 9 and 10.

Note on the Electrical Phenomena of the Heart.—Dr. J. P. Nuel.—Some new facts are here brought to light, among others, the positivity of the apex of the intact heart.

Meteorological Congress at Vienna.

Note on the Tendency of the Greater Axes of Cometary Orbits to take a Given Direction.—M. Houzeau.—The author finds that they show a well-marked tendency to become parallel to the heliocentric meridian of $102^{\circ} 20'$, or the double meridian of $102^{\circ} 20'$ and $282^{\circ} 20'$. A fact so well characterised certainly depends on a general cause, and one can hardly doubt that the phenomenon will develop more and more in the future.

Universal Meteorographic System.—M. van Rysselberghe.—This paper describes an ingenious meteorograph

invented by the author, and now in action at Ostend, which registers at once the direction of the wind, its velocity, the atmospheric pressure, and the temperature of the air. He proposes, also, to make it register hygrometric and magnetic phenomena.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

An improved apparatus for analysing gas. Louis Hengist Orsat, engineer, 19, Rue de la Victoire, Paris. May 22, 1873.—No. 1853. This invention relates to apparatus for analysing gases, consisting of a measuring-tube connected at bottom by a flexible pipe with a vessel containing water, which can be raised or lowered so as to expel gas from, or draw gas into, the measuring-tube. This tube is connected at top by pipes provided with stopcocks with several bell-jars immersed in solutions suitable for absorbing various gases, in which vessels are placed numerous glass tubes or rolls of wire gauze, which present large absorbent surfaces. The gas to be analysed having been drawn into the measuring-tube, is thence forced into, and drawn back from, the successive bell-jars a sufficient number of times to have its several gaseous ingredients absorbed therein, the difference of measure indicated in the measuring-tube furnishing the quantitative proportions of those ingredients. With the gas-tubes are connected, with proper stopcocks, a water-pipe and funnel for cleansing the interior of the apparatus.

Improvements in the treatment of copper pyrites and iron ores to free them wholly or partly from earthy or extraneous matters. John Richardson Francis, merchant, member of the firm of J. C. Richardson and Co., Swansea, Glamorgan. (A communication from François Alexandre Hubert La Rue, Quebec, Canada). May 23, 1873.—No. 1865. The object of the invention is to separate quartz, shales, siliceous and other extraneous earthy matters from copper pyrites and iron ores. The invention consists in pulverising the ore, then roasting it, though this may in some cases be dispensed with, then heating it with carbon or reducing gases to ensure at least a partial reduction of the iron ore, which then becomes magnetic: then passing the material thus treated through a magnetic or electro-magnetic machine, to separate the ore from the earthy residue. In the case of copper pyrites, the iron which is rendered magnetic is separated in combination with the copper ore.

An improved process for the production of aluminium. Richard Werdermann, civil engineer, Princes Street, Surrey. May 29, 1873.—No. 1933. The said invention consists in a novel process for producing the metal aluminium without employing metallic potassium or sodium.

An improved process for the conversion of chlorides and fluorides of alkaline metals and alkaline-earth metals into oxides, hydroxides, and carbonates. Richard Werdermann, civil engineer, Princes Street, Surrey. May 29, 1873.—No. 1934. This invention consists mainly in a new process for effecting the direct conversion of chloride of sodium into caustic soda without the employment of sulphuric acid.

Improvements in treating sewage or other liquids or substances containing nitrogen, phosphorus, or their compounds, in order to deodorise or precipitate the same, and obtain useful products therefrom. Joseph Townsend, manufacturing chemist, Glasgow, Lanark, N.B. May 31, 1873.—No. 1967. This invention has for its object the deodorising and purifying, or partial purifying, of sewage or other liquids or substances containing nitrogenous matter or phosphorous compounds, and consists in certain modes of using alumina, lime, magnesia, phosphoric acid, or combinations or compounds thereof.

A new and improved utilisation of linseed and other ingredients for the manufacture of certain medical compounds. Samuel Kay and Thomas Kay, chemists, Stockport, Chester. May 31, 1873.—No. 1975. The lozenge (styled a "linseed lozenge") is made by mixing highly concentrated extract of linseed with pounded sugar; the product or mass in a plastic state, after being rolled and moulded to the desired form, is dried in a heated room, or in any other convenient manner. Another lozenge (styled a "chlorolinseed" or "klorolinseed lozenge") is made by taking the mass in a plastic state, compounded as above, and adding thereto in due proportions any medicament, such as chlorodyne, strong chloric ether, or chloral hydrate, preference being given to a chlorodyne made with morphia meconate combined with an expectorant, as ipecacuanha or antimony, in approved doses. The mixture (styled "compound essence of linseed") contains in a concentrated state, the fluid extract of senega, scilla, papavera, chiretta, or other tonic, ipecacuanha or antimony in wine, or both in approved official doses. The clear liquor is emulsified with linseed by decoction. The product strained is further medicated with a distillate of star aniseed, cherry laurel, tolu balsam, gum benjamin, sulphuric or chloric ether, and sufficient mucilage to produce a mixture perfectly homogeneous. The pill (designated "vegetable pills of the linum catharticum") contains the extract of purging linseed (or, as it is commonly called, mountain flax), evaporated to a plastic state, and mixed with other vegetable substances, as rhubarb, aloes, myrrh, cardamoms, mandrake, hyosciamus, and gentian extract, to which, for the purpose of keeping the ingredients soluble and active, is added a due proportion of castile soap.

Improvements in the manufacture of cements. Reverend Granville Hamilton Forbes, Rector of Broughton, Northampton. June 4, 1873.—No. 1999. The inventor mixes refuse or foul lime from gas-works, for instance, with any marl or fine clay containing the necessary quantity of silica and alumina for the purposes of the said invention above referred to, in the proportion of about from 70 to 80 parts of the lime to about 30 or 20 parts of the clay in every hundred pounds by weight of the compound. I do not, however, limit myself (says the inventor) to

the above proportions, as the quantity of sulphur in the foul lime leads to variations.

MEETINGS FOR THE WEEK.

MONDAY, 20.—Medical, 8.

— Society of Arts, 8. Cantor Lectures.
— London Institution, 4.

TUESDAY, 21.—Civil Engineers, 8.

— Zoological, 8.30.

— Anthropological, 8.

— Royal Institution, 3. Prof. Rutherford, "The Nervous System."

WEDNESDAY, 22.—London Institution, 7.

— Society of Arts, 8. Mr. W. C. Aitken, "On Progress Recently Made in Ornamental Processes Connected with Metallic and Other Industries."

THURSDAY, 23.—Royal Institution, 3. Mr. W. N. Hartley, "On the Atmosphere."

— Royal, 8.30.

— Royal Society Club, 6.

FRIDAY, 24.—Royal Institution, 9. Mr. C. W. Merrifield, "On Sea Waves."

— Society of Arts, 8. Dr. C. R. A. Wright, F.C.S., "On Pyrites as a Source of Sulphur, Copper, and Iron."

— Quekett Microscopical Club, 8.

SATURDAY, 25.—Royal Institution, 3.

TO CORRESPONDENTS.

ERRATA.—Page 161, column 1, lines 12 and 19 from bottom, for methyl-ethyl-keton read methyl-hexyl-keton.

J. Andrews.—Dr. Morfit's treatise on soap is published by Messrs. Trübner and Co.

L. J. B. and Co.—An advertisement in our columns will be sure to elicit answers.

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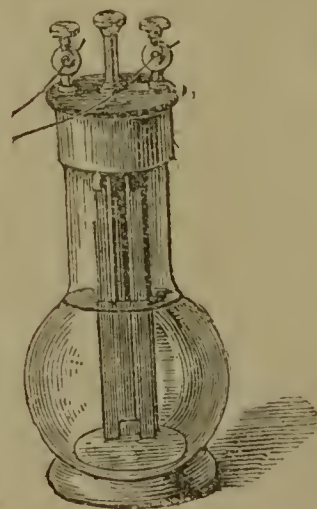
PATENTS.

MR. VAUGHAN, F.C.S., Memb. Soc. Arts,
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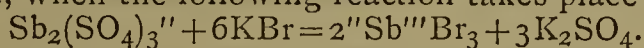
THE CHEMICAL NEWS.

VOL. XXIX. No. 752.

ON ANTIMONY TRIBROMIDE.

By R. W. EMERSON MACIVOR.

THIS compound, the only known combination of bromine with antimony, is most easily procured by the gradual addition of powdered metallic antimony to dry bromine, contained in a tubulated glass retort, until light is no longer emitted, and then submitting the product to distillation. It may also be obtained by heating an intimate mixture of antimonious sulphate with dry potassium bromide, when the following reaction takes place:—



Antimony tribromide forms upon cooling a colourless solid substance, crystallising in needles, and fusing at 90°C . to a pale greenish-yellow-coloured liquid, which boils, under an atmospheric pressure of 760 m.m., at or near 283°C . When in the melted condition it has a specific gravity = 3.473 at 96°C . It attracts moisture from the air with great avidity, and is immediately decomposed by water. It dissolves in hydrochloric and hydrobromic acids, alcohol, and ether. Carbon disulphide also dissolves it, and its solution in this menstruum, when allowed to evaporate, deposits the compound crystallised in beautiful quadrangular needles. It is readily decomposed by strong nitric acid, even in the cold. When in the liquid state it dissolves sulphur, but does not form a definite compound with it. When subjected to the action of a stream of dried ammonia it absorbs a quantity of the gas, and a yellow non-crystalline substance results, consisting most probably of $\text{SbBr}_3 \cdot \text{NH}_3$. When antimony bromide is intimately mixed with dry potassium iodide, and the mixture is heated, orange-red vapours are formed, which condense on the cooler parts of the apparatus in the form of magnificent scarlet-coloured transparent scales, consisting of antimony tri-iodide.

Antimony tribromide is, as already mentioned, readily decomposed by water, the products of the action being free hydrobromic acid and an oxybromide. The composition of the latter varies with the temperature of the water used for its precipitation. The slimy white precipitate formed when SbBr_3 is acted upon with cold water consists of a definite oxybromide, mixed with varying quantities of undecomposed tribromide. In order to separate the tribromide, the precipitate should be collected on a filter, dried in an air-bath, and then washed with pure carbon disulphide until no more tribromide is dissolved out. The substance remaining on the filter has then a composition corresponding to the formula $\text{Sb}_4\text{Br}_2\text{O}_5$, or $2\text{SbBr}_3 \cdot 5\text{Sb}_2\text{O}_3$, as the following results of the analysis of two different samples show:—

		Found.		Calculated.
Sb	..	66.89	66.85	67.04
Br	..	22.21	22.17	21.99
O	..	10.90	10.98	10.97
		100.00	100.00	100.00

The granular white precipitate formed by pouring the liquid tribromide into boiling water has a constant composition, and consists of a compound of 10 molecules of the above oxybromide with 1 of the tribromide. These figures are the results of the analysis of two specimens of this body:—

Sb	..	65.38	65.41
Br	..	24.16	24.32
O	..	10.46	10.27
		100.00	100.00

The theoretical percentage composition of a substance having the formula $10\text{Sb}_4\text{Br}_2\text{O}_5 \cdot \text{SbBr}_3$ being—

Sb	..	65.45
Br	..	24.08
O	..	10.47
		100.00

By washing this compound with carbon disulphide, 1 molecule of the tribromide is dissolved out, and the oxybromide $\text{Sb}_4\text{Br}_2\text{O}_5$ remains.

Antimony oxybromide is decomposed when heated to about 300°C ., SbBr_3 being volatilised, and antimonious oxide remains behind. It is also decomposed by long-continued washing with water, hydrobromic acid being dissolved out, and antimonious oxide left. It is insoluble in alcohol, ether, or carbon disulphide, but is easily dissolved by hydrochloric acid. A solution of tartaric acid also dissolves it.

67, Park Road, Glasgow,
April 10th, 1874.

AN EXPERIMENT ON SEA-WATER.

By E. SONSTADT.

IN the postscript to a letter commenting on the discovery of vanadium in traprocks, I stated that when sea-water was saturated with pure iodate of potassium, vanadium, and a metal resembling, or that probably was, osmium, could be detected in the precipitate. I had trusted that some one having better opportunities than I have for doing such work would have been moved to examine sea-water in the way indicated; and I thought that such an examination, properly carried out, could not fail to yield very interesting results. As it is, however, it seems to me worth while to place on record such small progress as I was able to make myself in the separation from sea-water of this osmium-like metal, and in the examination of the very small quantity I was able to obtain.

The iodate of potassium used in these experiments was prepared by concentrating a solution of the ordinary iodate, so that it should crystallise. The iodate that crystallises out is coloured, and when examined with borax before the blowpipe in sufficient quantity gives a coloured bead. The supernatant liquid is then filtered, and concentrated so as to give another crop of crystals, which latter are not only colourless, but remain so on exposure to the air (if protected from dust), and do not colour a bead before the blowpipe. The pure iodate was dissolved in boiling water to saturation, and the solution added to sea-water in such proportion that the liquid when cold should be about saturated.* A day or two is allowed for the precipitate to form. This precipitate, when filtered off, and exposed moist to the air for a few days, gives out a very disagreeable odour, which reminded me of the odour sometimes perceivable when platinum wire is melting in a hydrogen flame. This, together with a peculiarity about the odour of the chlorine evolved when the precipitate is treated with hydrochloric acid, directed me to look for osmium. After some preliminary experiments, to guide me in overcoming the difficulty arising from the presence of iodine in the precipitate (which is essentially iodate of calcium), I proceeded as follows:—

The precipitate was put into a retort, and a large proportion of pure hydrochloric acid poured in. The chlorine, which was copiously evolved, was received in a strong solution of sulphide of ammonium. When the action in the retort had nearly ceased, heat was applied, and gradually raised so as to keep the liquid in constant ebullition. As the temperature rose, chloride of iodine came over, and as iodine and iodide of sulphur began to

* In some experiments I have evaporated the sea-water to a fourth of its volume before adding the solution of the iodate of potassium, so as to economise the latter.

separate in the receiving vessel, fresh additions were made of sulphide of ammonium. After a while a permanent dark brown precipitate began to make its appearance. It was necessary to add sufficient sulphide of ammonium from time to time to re-dissolve precipitated sulphur. The brown precipitate increased most when the liquid in the retort had attained a high boiling-point and was strongly coloured by iodine. A little nitric acid was then poured into the retort, and the distillation continued as long as was safe to the vessel. A small quantity of a black precipitate appeared in the retort, which precipitate remained to the end.

Next, a quantity of iodate of potassium from the stock that furnished what was used in the sea-water experiment was distilled with hydrochloric acid of the same stock as before, and the distillate was received in sulphide of ammonium of the same stock as before. Similar quantities were used, and the experiment in all respects was conducted as before. There was no permanent coloured precipitate in the receiving vessel. This appeared conclusive proof that the sulphide obtained in the previous experiment was the sulphide of a metal derived, not from the reagents taken, but from the sea-water.

The sulphide obtained in the first-mentioned experiment was collected on a filter, washed with solution of sulphide of ammonium and with a little water, and was drained and cautiously dried. The sulphide was then put into a porcelain boat, which, placed in a tube, was heated to low redness while hydrogen was transmitted over it. A black, very light powder remained. A portion of this powder, heated in a closed tube, neither melted nor showed other sign of change at the highest temperature the glass would bear. But when a portion was placed on platinum foil, and held so as to touch the side of a spirit-lamp flame, it instantly passed off in fumes having a powerful disagreeable odour, allied to that of osmium, but there was no flash of light or increase in the illumination of the flame against the assay. I repeated the experiment several times, always with the same result. A little osmium, which I procured for comparison, when similarly held in the flame always gave the flash described by Fresenius. In other respects the phenomena were similar.

I tried to make some experiments in the wet way, but could do no satisfactory work with the few centigrammes that I obtained in all as the product of several experiments. Moreover, the greater part of this small quantity was consumed in the trials with the flame.

My best experiment gave 0.0124 grm. of the metallic powder from 2 litres sea-water. In this experiment sulphuretted hydrogen was passed for a long while through the partially decomposed sulphide of ammonium in which the distillate was received.

ON THE
CHEMICAL EXAMINATION AND COMPARATIVE
COMPOSITION OF SOME SPECIMENS OF
PRESERVED MEAT.*

By THOMAS ROBERTSON OGILVIE, F.C.S.,
Joint Public Analyst, Greenock.

I PROPOSE to give the details of the examination of specimens of the preserved mutton imported into this country from Australia and New Zealand. A short time ago a considerable discussion was carried on in some of the journals regarding the dietetic and economic value of preserved mutton, and various statements were made to the effect that it is considerably deficient in the nourishing constituents of butcher's meat, and that labouring men consume nearly double the quantity they would eat of

English meat in order to satisfy their appetite. Other statements testifying to the highly nutritive properties of this article were also given; but the whole correspondence was of a very general nature, and no evidence of a scientific character was produced to establish the real value of this substance, which has now become a staple article of food.

The following analyses were made in order that a definite estimate may be formed of the nourishing properties of preserved mutton compared with those of home mutton and other kinds of animal meat.

Much research has been bestowed on the discovery of a method of preserving the flesh of cattle reared abroad so that it may be imported in a fresh and palatable state. About 250 patents have been taken out in Great Britain, as well as a large number in the Colonies. Only one method, however, has been practically successful, and it is a modification of the old process of heating the meat in tins.

In carrying out this process, the meat is placed in tins, which, with the exception of a small aperture for the escape of air and steam during the operation, are sealed and made air-tight. The tins are placed in a chloride of calcium bath having the boiling-point of about 260° F., and kept there for four hours, then closed, and after remaining in the bath for another half-hour, are ready for shipment. The special object of this treatment is to ensure that the meat will remain fresh by the removal of the air and the destruction of all "microscopic germs."

There are three companies whose manufacture is specially known in this country, viz., the New Zealand Meat Preserving Company, the Australian Meat Preserving Company, and the Melbourne Meat Preserving Company, and a number of tins of the meat prepared by these companies were purchased in the ordinary retail way, and samples taken from the several lots for examination. When the tins are opened without being heated, their contents may easily be separated mechanically into three distinct portions, viz., jelly, fat, and lean, the proportions of which vary in every tin. Average samples of these separately, and also of the whole mixed together, were taken from a number of the tins of each manufacture. Four samples were thus obtained from each of the three kinds for analysis, viz.:—

(a). Jelly or gelatin.

(b). Fat.

(c). Lean.

(d). A sample of the three together, as found in the tins.

To enable me to make a comparison of the results with the composition of home mutton, I carefully selected pieces of the latter from three different animals, with the aim that they should be as nearly as possible average specimens of mutton as retailed in butcher's shops. The several specimens were freed from bones, and the whole finely minced together, and an average sample taken for analysis. Further, I procured a number of cans of extract of meat prepared by Liebig Company, mixed their contents, and from the whole took an average portion for examination, with the object of arriving at an estimate of the comparative value of the jelly in the tins of preserved meat. I thought it well to do this, as many of the working classes are in the habit of purchasing the jelly and the lean, and using them separately.

The following is the method of analysis adopted in the examination of these substances. The quantities given are those used in the analysis of the mutton, and were altered to suit the varying proportions of the constituents in the fat, jelly, and extract. The mutton was prepared by being thoroughly minced and well ground together.

(1). *Moisture*.—Two grains were placed in a watch-glass, dried at 212° F., and the loss noted as moisture. Some authorities suggest that 230° be adopted, but I found that all the moisture is driven off at this temperature.

(2). *Fat*.—Two grains were digested in a small stoppered bottle with successive portions of ether, which were

* Read before the Chemical Section of the Philosophical Society of Glasgow, February 23, 1874.

transferred to a weighed flask, the ether removed by distillation, and the fat dried and weighed.

(3). *Albumen*.—Twenty-five grains were placed in a beaker, covered with cold water, and allowed to stand for an hour with occasional stirring. The whole was then transferred to a piece of well-washed linen, the watery extract gently pressed through, and placed in a basin. The operation was repeated once with cold water, then three times with boiling water, the mass allowed to cool before being pressed in the linen. In the examination of raw or uncooked flesh, the filtrate was made slightly acid with acetic acid, and gently heated to about 170° F. to coagulate the albumen, then filtered through a weighed filter, and the albumen well washed and dried at 212° F.

The filtrate from the preserved mutton could not contain any soluble albumen, as in the process of preserving it was heated to about 260° F. During the evaporation of the watery extract, however, a small quantity of a body resembling fibrin separated, which was transferred to a weighed filter, washed, dried at 212° F., and called "soluble fibrinous matter."

(4). *Extractive Matter*.—The filtrate from the albumen was gently evaporated in a small basin, dried in the water-bath at 212° F., and weighed as the "total extractive matter."

It was then carefully removed from the basin, digested in a small flask with successive portions of 90 per cent alcohol, and the residue weighed as the watery extract. The alcohol solution was gently evaporated, and the residue weighed as the "alcoholic extract."

(5). *Fibrin*.—The residue, after digestion with cold and warm water was carefully removed from the linen cloth, dried in a large watch-glass at 212° F., and weighed as "fibrin."

(6). *Nitrogen*.—In portions of the extractive matter and fibrin the nitrogen was estimated in the usual way, by combustion with soda-lime.

(7). *Mineral Matters*.—Fifty grains of the mutton were dried, charred at a low red heat, and repeatedly digested with boiling water, the clear filtrate made up to 250 c.c., and phosphoric acid, sulphuric acid, chlorine, and alkalis, estimated in separate portions. The residue was thoroughly incinerated, and noted as insoluble ash.

The following is a table of the results of the analyses of the the various substances examined.

(A). *Comparative Composition of Foreign Preserved Mutton and Home Mutton.*

(a). *Water*.—The percentage of water in each of the three specimens of preserved mutton is higher than that in the home mutton, thus:—

No. 1 contains	..	..	59.26 per cent.
" 2	"	..	61.48 "
" 3	"	..	61.57 "
Home mutton contains			52.59 "

This difference was to be expected, as during the preserving process a special addition is made to the tins of a quantity of jelly or gelatin, the greater proportion of which is water.

(b). *Fat*.—There is also a wide difference in this constituent—

No. 1 contains	..	..	19.62 per cent.
" 2	"	..	14.62 "
" 3	"	..	15.79 "
Home mutton	..	..	28.88 "

No other element will vary more, and different samples may contain higher or lower proportions than these. I do not consider, however, that the preserved mutton should contain more than 14 to 20 per cent, as that is certainly a large enough quantity. It must be remembered that the home mutton was raw, and that before cooking it in the ordinary way portions of the fat would be removed.

(c). *Extractive Matters*.—The three varieties of preserved are richer in these matters than the home mutton.

	Alcoholic Extract.	Watery Extract.	Total.
No. 1 ..	2.47	4.47	6.94
" 2 ..	2.87	4.05	6.92
" 3 ..	3.12	3.82	6.95
Home mutton	2.28	1.85	4.13

(d). *Albumen and Fibrin*.—The albumen in the preserved mutton has been rendered insoluble by the boiling it undergoes during the preserving process, and as it cannot in that state be separated from fibrin, the two are classed together in the analyses.

	Albumen and Fibrin.
No. 1 ..	14.16 per cent.
" 2 ..	16.92 "
" 3 ..	16.39 "
Home mutton	14.40 "

One of the preserved specimens shows nearly the same proportion as the home mutton, while the other two contain 2.52 and 1.99 per cent respectively in excess.

During the evaporation of the solution of the extractive matters from the preserved mutton a small quantity of a body separated out, which is shown in the analyses as "soluble fibrinous matter," thus:—

No. 1 gave	..	..	1.27
" 2 "	..	..	2.32
" 3 "	..	..	1.59

Home mutton was cooked at the same temperature as the "preserved," and yielded 1.59 per cent of this substance, which I believe does not differ in composition or condition from ordinary fibrin.

(e). *Mineral Matters*.—The preserved contain larger quantities of these matters also than home mutton.

	Soluble.	Insoluble.	Total.
No. 1 contains	0.654	0.444	1.098
" 2 "	1.019	0.543	1.562
" 3 "	0.705	0.160	0.865
Home mutton	0.303	0.150	0.453

No. 2 contains a larger quantity than any of the others; the excess, as will be seen from the table of analyses, consists of common salt.

All the specimens of preserved mutton, therefore, are superior to the home mutton in the respect that they contain larger proportions of the specially valuable and nutritious ingredients.

It still remains to notice the—

(B). *Comparative Composition of Liebig's Extract of Meat, and the Jelly or Gelatin in the Tins of Preserved Mutton.*

The preparation known as Liebig's Extract consists of the juice of flesh from which the water, fat, gelatin, albumen, and fibrin have been more or less removed. It consists, therefore, essentially of the extractive matters of flesh.

The "jellies" contain the same bodies, but in smaller quantities, thus:—

	Alcoholic Extract.	Soluble Mineral Matter.
No. 1 contains	3.60	1.165
" 2 "	3.56	1.485
" 3 "	3.61	1.148
Liebig's extract	53.04	22.170

The jellies closely resemble each other in composition, and contain, on an average, 1 part of alcoholic extract for 14.77 in Liebig's extract, and 1 part of soluble salts for 17.5 parts in the extract.

In discussing these analyses, a very natural point to consider is the special function which each of the constituents of animal flesh serve in the human economy. Our knowledge, however, on this subject is extremely limited and undefined, owing very much to the great difficulty of experimenting on the effect of the several components of butchers' meat on a body so sensitive and complicated as the human organism. The peculiar merit of butchers' meat is that it contains, in well-balanced

COMPARATIVE STATEMENT OF ANALYSES OF FOREIGN PRESERVED MUTTON (INCLUDING JELLY, FAT, AND LEAN),
HOME MUTTON, AND LIEBIG'S EXTRACT OF MEAT.

	Foreign Preserved Mutton.												Home Mutton, uncooked.	Liebig's Extract of Meat.
	Average of whole contents of Tin.			Jelly or Gelatin.			Fat.			Lean.				
	1.	2.	3.	1.	2.	3.	1.	2.	3.	1.	2.	3.		
Water	59'26	61'48	61'57	88'07	88'43	87'95	28'15	33'60	24'51	61'38	63'20	65'42	52'59	17'20
Fat	19'62	14'62	15'79	0'83	0'29	1'45	65'77	61'11	68'34	12'48	6'70	6'52	28'88	0'14
Extractive matters:—														
(1). Alcoholic extract, including creatin, in- osic acid, lactic acid, mineral matter, and undefined substances	2'47	2'87	3'12	3'60	3'56	3'61	0'93	1'38	1'29	2'63	3'09	3'44	2'28	53'04
(2). Watery extract, including gelatin, mineral matter, and undefined substances	4'47	4'05	3'82	6'88	6'98	5'25	1'77	2'70	1'87	4'67	3'87	3'04	1'85	29'22
Soluble fibrinous matter	1'27	2'32	1'59	—	—	—	—	—	—	1'77	3'22	2'21	—	—
Soluble albumen	—	—	—	—	—	—	—	—	—	—	—	—	3'22	—
Insoluble	—	—	—	—	—	—	—	—	—	—	—	—	—	0'40
Myochrome, or colouring matter	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Fibrin or syntonin	12'89	14'60	14'80	0'62	0'74	1'73	3'38	1'21	3'99	17'06	19'92	19'37	11'18	—
	99'98	99'94	100'69	100'00	100'00	100'00	100'00	100'00	100'00	100'00	100'00	100'00	100'00	100'00
Soluble mineral matter:—														
Potash	0'235	0'298	0'241	0'405	0'440	0'440	0'104	0'184	0'157	0'237	0'315	0'229	0'136	9'78
Soda	0'107	0'193	0'098	0'238	0'332	0'207	0'061	0'112	0'073	0'110	0'191	0'088	0'065	2'48
Phosphoric acid	0'160	0'151	0'237	0'325	0'371	0'332	0'084	0'078	0'118	0'151	0'133	0'250	0'056	7'89
Chlorine	0'152	0'377	0'129	0'197	0'342	0'169	0'057	0'242	0'069	0'167	0'414	0'137	0'046	1'76
Sulphuric acid	—	—	—	—	—	—	—	—	—	—	—	—	—	0'26
Insoluble mineral matter	0'444	0'543	0'160	0'250	0'110	0'440	0'064	0'064	0'157	0'698	0'646	0'116	0'150	0'91
	1'098	1'562	0'865	1'415	1'595	1'588	0'370	0'994	0'574	1'363	1'699	0'820	0'453	23'08
Nitrogen in extractive matters	0'931	0'913	0'862	—	—	—	—	—	—	—	—	—	0'536	—
Nitrogen in albumen and fibrin	1'809	2'314	2'206	—	—	—	—	—	—	—	—	—	1'947	—
	2'740	3'227	3'068										2'483	9'05

proportions, the several constituents of our bodies; and I think it is a fair and legitimate method of arriving at the constituent value of meat offered to the public from a new source, such as the preserved mutton under consideration, to compare it with home-grown butchers' meat of good quality.

One conclusion we may draw from the many experiments that have been made on the dietetic value of fat, gelatin, albumen, and fibrin is this, that when any of them are taken alone they cease to have the nourishing effect which they would have if taken together as they exist in flesh. These bodies are co-relatives.

Thus fat is not only indispensable in the process of repair of all cellular and fibrous matter, but is also necessary for the digestion of the other elements of food. Gelatin alone cannot support nutrition, but, as Voit has shown lately, it is highly valuable in conjunction with certain proportions of albumen and fat. But even gelatin, albumen, fibrin, and the other life-sustaining bodies, when eaten alone or mixed together, entirely fail in supporting the system if destitute of certain mineral substances, such as phosphate of potash and chloride of potassium. These bodies are present in comparatively small proportions, but are nevertheless of primal importance, as without them the other bodies could not be ingested. It is thus of the highest consequence that the preserved meat sent from the Colonies should have the normal composition of good butchers' meat, and that care be taken that none of the constituents, such as fat and gelatin, be present in undue proportions.

What, then, is the value of Liebig's extract of meat and the jelly of the preserved mutton, seeing they are nearly devoid of such nourishing bodies as fat, albumen, and fibrin? They are certainly not "foods," as they contain nothing that can renovate the organic tissues. They are stimulants of the same class as tea and coffee, and contain an alkaloid, creatin, corresponding in chemical relation and constitution to theine and caffeine.

This peculiar body, creatin, is also associated with other active principles, such as lactic acid, inosic acid, and

certain bodies which as yet are undefined. They are all included under the term alcoholic extract, and, along with the potash salts present, are believed to have the special property of stimulating muscular strength, just as the other alkaloids named excite mental activity. Hence, the restorative power on invalids of Liebig's extract and beef-tea (which is virtually the same as the extract). The jelly of the preserved mutton also has the same quality, but in a less degree, as it contains the same bodies, but in much smaller proportions.

Owing to the high price of Liebig's extract, it cannot become available to the working classes for the making of soup, but if such jelly could be sold at a cheap rate it might come into use, especially by the operatives in cotton factories, who at present use tea to an extent which is highly injurious. If taken with butter and bread it would act, not only as a vital restorative, but as real nutriment. The gelatin alone would be useless for the support of life, but in conjunction with the salts present in the jelly, and the fat or butter, would be eminently valuable as an article of nourishment.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 16th, 1874.

Dr. ODLING, F.R.S., President, in the Chair.

THE minutes of the previous meeting having been read and confirmed, Messrs. J. Smyth, Howard Barrett, H. L. Greville, T. M. Nishigaiva, G. H. Beckett, and A. J. Greenaway, were formally admitted Fellows of the Society.

The donations to the library were then announced, after which the names of Messrs. Charles Edward Bean and H. H. B. Shepherd were read for the first time.

For the third time—Messrs. Frederick W. Fletcher

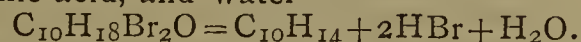
Alfred A. Wolff, and William Pearce, jun., who were then ballotted for and duly elected.

The first paper, "*On Aqua Regia and the Nitrosyl Chlorides*," was read by the author, Dr. A. W. TILDEN, who was induced to undertake this research in hopes of being able to obtain nitroso-compounds by the action of nitrosyl chloride, NOCl, on organic bodies. As no process existed for the preparation of this substance in quantity, the author devised the following:—The gases evolved on gently heating aqua regia were dried by calcium chloride, and then passed into concentrated sulphuric acid to saturation. The product, when exposed to a low temperature, deposits crystals having the composition NOHSO_4 . These melt at 85° to 87° , and possess the characters of the ordinary sulphuric acid chamber crystals. Attempts to obtain a dinitrosyl sulphate, $(\text{NO})_2\text{SO}_4$, were unsuccessful; on mixing either the crystals or the sulphuric acid saturated with the aqua regia gases with dry sodium chloride, and gently heating, nitrosyl monochloride is at first given off— $\text{NOHSO}_4 + \text{NaCl} = \text{NaHSO}_4 + \text{NOCl}$. When this has ceased, the application of a stronger heat causes the evolution of torrents of hydrochloric acid. The pure nitrosyl chloride thus obtained is an orange-yellow gas, which may be condensed to a mobile liquid of a deep orange colour, boiling at -8° . It attacks platinum and gold, but only very slowly. The existence of the remarkable dichloride, NOCl_2 , which, according to Gay-Lussac, occurs among the products of the decomposition of nitric acid by hydrochloric acid, seemed doubtful, as no compound having any analogy with it is known, except the vanadyl dichloride, VOCl_2 , of Roscoe. The author endeavoured to prepare this substance by fractionally distilling nitrosyl monochloride saturated with chlorine, but no definite compound could be obtained; a similar result ensued on examining the liquid produced by condensing the gases from aqua regia: from this it would appear that the monochloride is the only definite nitrosyl compound obtainable from aqua regia, the reaction being $\text{HNO}_3 + 3\text{HCl} = \text{NOCl} + \text{Cl}_2 + 2\text{H}_2\text{O}$. Gay-Lussac's dichloride was probably a solution of chlorine in the monochloride. The action of nitrosyl sulphate on potassium bromide does not give nitrosyl bromide, but nitric oxide and a dark liquid which could not be distilled without the evolution of the same gas. It was not further examined.

The PRESIDENT, in thanking Dr. Tilden, said that the subject of which he had treated was one of very great interest to chemists, and the results he had obtained satisfactorily proved the existence of the compound NOCl, which, if he remembered rightly, Gay-Lussac had passed over with very slight notice, his attention being directed to the mixed body which he supposed to be the dichloride. This compound, whose existence Dr. Tilden had shown to be more than problematical, would be the legitimate analogue of nitric peroxide.

In reply to a question of the President, Dr. TILDEN said that Roscoe's vanadyl dichloride was a green crystallisable body of definite composition, but, as it did not seem to be volatile, there was no means of determining its molecular weight.

Dr. C. R. A. WRIGHT then read a paper on "*Isomeric Terpenes and their Derivatives; Part IV.*"—1. *On Cajeput Oil*," by C. R. A. WRIGHT, D.Sc., and T. LAMBERT. By carefully fractioning oil of cajeput, an oil, cajeputol, was obtained, boiling between 176° and 179° , and having the composition $\text{C}_{10}\text{H}_{18}\text{O}$, isomeric with the citronellol described in Part III. Like the latter, it combines with 2 equivalents of bromine, forming the compound $\text{C}_{10}\text{H}_{18}\text{Br}_2\text{O}$, which, when heated, splits up into cymene, hydrobromic acid, and water—



This cymene, when purified, boiled at 176° to 177° , and, on oxidation, yielded terephthalic acid free from isophthalic acid, so that it is identical with that obtained from the other terpene derivatives.

2. *Action of Pentasulphide of Phosphorus on Terpenes and their Derivatives*, by Dr. C. R. A. WRIGHT. On treating

cajeputol with its own weight of the pentasulphide, a vigorous reaction takes place, and a hydrocarbon distils over, which appears to be a mixture of cymene and a terpene, the former predominating. As it seemed probable that the cymene might result from the action of the pentasulphide on the terpene— $\text{C}_{10}\text{H}_{16} + \text{S} = \text{C}_{10}\text{H}_{14} + \text{H}_2\text{S}$, the terpene from turpentine oil, boiling at 159° , and hesperidene, boiling at 178° , were digested with an equal weight of phosphorus pentasulphide, when a continuous evolution of sulphuretted hydrogen took place, and much of the hydrocarbon was resinified, but about 30 to 40 per cent distilled over, consisting almost entirely of cymene. It would seem that the class of bodies known as terpenes, and their derivatives of the form $\text{C}_{10}\text{H}_{16}\text{O}$ and $\text{C}_{10}\text{H}_{18}\text{O}$, are closely connected with cymene, so that this hydrocarbon may be regarded as the central form of matter from which these classes of substances are derived by operations similar in character for all members of a given class, but differing apparently in the extent to which energy is involved in each operation respectively.

The PRESIDENT said the Society was much indebted to Dr. Wright for the continuation of his investigations of the ten carbon bodies. It was curious that the vegetable kingdom should yield such a vast supply and so great a variety of the ten carbon bodies, and not other benzene derivatives containing C_9 , C_7 , &c. He believed that other bodies existed having the same percentage composition as the terpenes, but only half the vapour density, so that they might be considered as five carbon bodies; he would like to ask whether any relation had been made out between these and the ten carbon bodies.

Dr. WRIGHT replied that this subject had been but little examined. It was a curious fact that, although we could obtain the polymerides from the C_{10} bodies, we could not perform the inverse operation, and unpolymerise them, so to speak,—that is, convert C_{15} or C_{20} compounds into C_{10} bodies.

The meeting was then adjourned until Thursday, May 7, when there will be papers "*On the Constitution of Urea*," by Dr. D. Tommasi, and "*Researches on the Action of the Copper-Zinc Couple on Organic Bodies; Part VII., On the Chlorides of Ethylene and Ethylidene*," by Dr. J. H. Gladstone and Mr. A. Tribe.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, March 24th, 1874.

Rev. WILLIAM GASKELL, M.A., Vice-President, in the Chair.

"*A Few Observations on Coal*," by E. W. BINNEY, V.P., F.R.S., F.G.S. Of late years much has been written on the structure of coal and the various vegetable remains of which it is composed. Observers examining different coals under the microscope have, as might be expected, come to different conclusions. Some of them have found little else than the remains of spores and spore cases, others only scalariform and cellular tissues and a few spores, and a third class little trace of any structure whatever in the specimens they examined. Splint or hard coal would generally afford the results first named, soft caking or cherry coals the second, and cannel coals the third.

Soft coals, yielding a large amount of charcoal enclosed in bright coal, nearly always show plenty of structure in the "mother coal," as well as a few macrospores in the bright portions. Macrospores are nearly always found in abundance in splint and hard coals. In cannel coals they are sometimes found as well as the cellular and scalariform portions of plants.

For many years macrospores were known by the names of spore cases and spores. They could be easily observed by the naked eye in the black parts of the coal, and they were generally considered as sporangia; but Professor Adolphe Brongniart in 1868 described a cone (*Lepidostrobus*

Dabadianus) having sporangia full of very minute spores, in fact microspores, in the upper portion, and sporangia full of macrospores, which had been so long known, in the lower part. These observations of Brongniart have been amply confirmed by specimens from the British coal-fields.

Thirty years ago it was considered that the soft or cherry coals were chiefly composed of the remains of large plants such as *Sigillaria*, *Lepidodendron*, &c., while caking coals were formed of plants of a lesser size and much bark, for it had then been observed, and since confirmed, that the outsides of *Sigillaria* and other fossil trees, sometimes reaching to 2 or 3 inches in thickness, were chiefly composed of bright soft coal showing little traces of structure.

In the great lawsuit which was tried at Edinburgh more than twenty years since as to the nature of Boghead coal, much evidence was given as to its structure, some witnesses finding in it scarcely anything else than the remains of vegetables, whilst others found only a stray portion of scalariform structure or a macrospore. Both Boghead and the other brown cannels of Scotland are now generally considered to afford but little evidence of vegetable tissues under the microscope, although numerous remains of *Sigillaria* and other common coal plants can be seen by the naked eye in them. Notwithstanding that they are so rich in volatile matter, and far exceeding other coals in their yield of paraffin and paraffin oils, they contain from 25 to 30 per cent of mineral matter in the form of ash. This circumstance has induced certain scientific men to class them as shales rather than coals, notwithstanding that they have the specific gravity of coals.

Some years since, when describing several fossil cones affording both kinds of spores, he expressed an opinion that the yellow matter seen in the vesicles of Boghead coal was nothing but microspores composed of paraffin or a similar hydrocarbon, and that they were driven off by heat in the form of a yellow vapour, leaving nothing behind but a spongy mass of earthy and carbonaceous matter. The evidence that caused him to come to this conclusion was that the microspores contained in the upper sporangia of *Lepidostrobus Harcourtii* had all the appearance of crude paraffin, and were of the same yellowish brown colour as powdered Boghead coal, and that the latter substance was composed nearly altogether of microspores and mineral matter. So far as his observations extended, microspores had not been observed in coal, although plenty of macrospores, which are generally 1-20th to 1-25th of an inch in diameter, and easily seen by the naked eye, had long been noticed.

He had some time since directed his friend, Mr. J. W. Kirkby, of the Pirnie Coal Company, to examine the Fife-shire seams of coal in search of microspores, most of those beds yielding macrospores in great abundance, and that gentleman had lately furnished him with the specimens now exhibited, both splint and soft coals, but especially the former, affording the two kinds of spores. On burning the yellow coal composed of microspores, a most brilliant flame and a peculiar empyreumatic odour like that from burning Boghead coal were produced, whilst the splint coal full of macrospores only burnt and smelt like ordinary hard coal, thus clearly showing that these two kinds of spores differed very much in their inflammable properties and odours given off, and that such properties were certainly not due to the larger spores, but most probably to the smaller ones.

The compressed lenticular bodies in the splint coal were formerly of oval and spherical forms with a triradiate ridge on one half, and although their exterior was composed of a brown coriaceous substance, their interior was full of white carbonate of lime, or bisulphide of iron, according to the nature of the matrix in which they were found; thus suggesting the idea of their having been filled with granules of starch when in a living state, which it is probable they would have been in case of their being germinating spores.

He and his late partners at Bathgate, when manufacturing paraffin oil there, had tried various means, by subjecting Boghead coal to the action of ethers and naphthas, to dissolve out paraffin from it, but they had never succeeded; so the yellow matter in the coal may probably be changed into paraffin by the heat employed in distillation. Dr. Schorlemmer, F.R.S., who has been so kind as to examine the microspores found in the Muiredge splint coal, is of opinion that they are not composed of paraffin, but some other hydrocarbon. This may, therefore, change into paraffin by the application of heat in a similar way to what the yellow matter in Boghead coal does.

The macrospores are about 320 times the size of the microspores and constituted the germinating spores, while the microspores were the fertilising agents, both having been contained in one cone.

Several specimens of fine bright soft coal, between two and three inches in thickness, taken from the outsides of *Sigillaria* and other fossil trees, were exhibited. In these there was no appearance of charcoal, spores, or vegetable structure, and in every respect they resembled the black shining parts of soft cherry and caking coals, which generally afford no distinct traces of vegetable structure. Hence from his observations he was led to conclude that soft or cherry coal was chiefly composed of the bark, cellular tissue, and vascular cylinders of coal plants, with some macrospores and microspores.

That caking coal had much the same composition, except that it contained a greater proportion of bark in it.

That splint coal had a nearly similar composition, but with a great excess of macrospores.

That cannel coal, especially that yielding a brown streak, was formed of the remains of different portions of plants with a great excess of microspores, which had long been macerated in water.

These conclusions were arrived at merely as to the composition of the different kinds of coal. No doubt each seam would be materially affected by the nature of the roof, whether the latter was an open sandstone or a close and air-tight black shale or blue bind, for the former would allow the free escape of gaseous matter, and the latter would prevent its escape. It is well known that the character of the roof has a deal to do with the quality of the coal under it.

CORRESPONDENCE.

DEHYDRATION OF COBALT SALTS.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS, vol. xxix., p. 161, there is a report of the meeting of the Chemical Society which contains a notice of Mr. Noel Hartley's interesting communication upon "The Cobalt Bromides and Iodides." In that paper it is shown that the change of colour in the salts named is due to the state of hydration. In the discussion that followed Mr. Clowes pointed out that dehydration of cobalt salts in solution took place in sealed tubes when submitted to a temperature above 100° C.

Not having been present at the meeting I do not know if these remarks were put forward as original observations, but I think it may be as well to point out that the dissociation of water of hydration of all salts, although in solution, always takes place providing the "thermanalytic point" (temperature of dissociation) is reached. The thermanalytic point will vary with the amount of dilution, but is generally above 100° C., and therefore such phenomena can only be reached when the solutions are heated under pressure. The production of anhydrous salts of cobalt in aqueous solutions is detailed amongst other experiments in my original paper, which was read at the Royal Irish Academy, in January, 1872, and which appeared in your

periodical in the same year (*Vide Proceedings of the Royal Irish Academy*, vol. i., series 2, p. 247).—I am, &c.,

CHARLES R. C. TICHBORNE.

Dubl'n, April 15, 1874.

SALT-CAKE OR CRUDE SULPHATE OF SODA.

To the Editor of the Chemical News.

SIR,—Your correspondents appear to have overlooked the fact of the presence of HCl, which would of course be thrown down on addition of AgNO₃, together with the NaCl, and if not taken into consideration the percentage of undecomposed NaCl will in many cases be overrated. This error may be avoided by first treating a portion of the crude sulphate with NH₄HO and igniting, then determine NaCl in usual way. Mr. Tenniswood does not make any allowance for CaSO₄, which is invariably present to a considerable extent (say from 0.80 to 1.20 per cent).

Subjoined is analysis of average sample, which may be useful for comparison:—

Sodium sulphate	96.50
Sodium chloride	0.75
Hydrochloric (free acid) ..	0.54
Sulphuric " "	0.46
Calcium sulphate	1.00
Ferric oxide	0.30
Silica	0.25
Moisture	0.20

100.00

The silica, ferric oxide, and calcium sulphate may, for practical purposes, be set down at 1.50 per cent.—I am, &c.

WM. SIMMONDS.

Oldbury, near Birmingham,
April 15, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, March 2, 1874.

Descending Movement of Solar and Terrestrial Trombes, and on the Formation of their Opaque Sheaths.—M. Faye.—A reply to Dr. Reye. Distinguish in the terrestrial whirlwind the rapid rotation of the "tool" (to use a former comparison), the movement by which it nears or goes away from the obstacle (the ground), and the progressive narrowing of the helices downwards. The gyratory movement, and formation of conical funnels, are easily explained by difference of velocity in currents. The whirlwind, once formed, stores up, in a narrowing space, the *vis viva* resulting from the inequalities of velocity, carries it downwards to the ground, while travelling in the direction and with the mean velocity of the current. As to the mode of vertical transmission, conceive, first, a solid ring rotating in a fluid. At each point of the turning surface the layer in contact will be forced in the direction of rotation, and the molecules thus forced will be replaced immediately by others which are near, but do not participate in the movement. But the reactions thus produced will not be equal in all directions. Above the ring the work of the fluid replacing the displaced layer is favoured by gravity, while below it is hindered. There is thus a slight excess of pressure from above downwards, increasing with the velocity of rotation. The solid ring would gradually descend (supposing the experiment realisable), and if it were a little lighter than the fluid this excess of pressure might dominate over its ascending tendency; but if the velocity of rotation fell below a certain

limit the ring would rise again, more slowly, however, than if it were not turning. Suppose, now, the ring fluid; the effects will be somewhat different. Each element, besides its rotation about a vertical axis, will be solicited by light pressure from above to turn about a horizontal axis, and this second rotation will be combined with the first. The resulting axis of rotation will be inclined at a small angle, and, the pressure being constant, the plane of gyration of the element will wind conically downwards. In other words, this element and all that follow will take the figure of a descending helicoidal spiral. We see, then, that the turning ring will be decomposed into threads like those of a screw having a descending movement; so long, at least, as the vertical reaction from above exceeds the contrary reaction. If the rotation diminish this effect will also; if the density of the ring be less than that of the surrounding fluid the helicoidal movement, stopped for a moment, may become ascending. This difference in density will not occur in liquids; it is only in gases that the descending movement may become an ascending one. But do not misconceive; a gaseous whirlwind may rise again to the point whence it descended, but there are no ascending whirlwinds, in the ordinary sense of the word, unless in very special circumstances that are here out of the question; and even then the phenomenon shows neither the progress nor the energy of the trombes, properly so-called. Next as to the contraction of the descending helices. On the one hand, rotation of the helices produces centrifugal force; on the other, the air imprisoned in the trombe is involved in the descending gyratory movement, and causes within a sensible diminution of pressure, while the motion in which the exterior air in contact with the helices is involved is counterbalanced by afflux of the surrounding fluid. Accordingly the horizontal actions at each point have, in general, a direction from without inwards; these combining with the vertical actions, we find the final resultant to be inclined at once downwards and towards the axis, so as to produce both descent of the helices and their progressive contraction. These are consequently formed on a surface of revolution of conical form, the contracted part being below. But if the density of the air carried down by the trombe do not increase as quickly as that of the medium, and if the movement of descent be weakened, the inverse effect may occur; the centrifugal force preponderating will enlarge the bottom of the trombe into a sort of divergent watering-pot (*arrosoir*) of which the parts which become independent of the whirlwind will rise again into the atmosphere. Such is the general case in the sun, where there is not a resistant ground to cut short the vertical propagation of the trombes. Nearly all the foregoing applies to water-courses as to media, but in the atmosphere a new influence is added; the air of the upper regions descending in a trombe is colder than the layers it crosses. It condenses the moisture of the interior air, and therefore the elasticity of this will diminish. We find quite analogous effects in the sun. And about the trombe this cooling extends to some distance beyond all appreciable movement, a sheath of vapours may thus be formed. The author proceeds to show how the phenomena described by M. Mouchez in a recent letter are explicable only on his theory, and to indicate how the phenomena of our water-spouts would appear to a spectator at a considerable distance from the earth.

Meteorology of the Month of January, 1874, at Tongourt.—M. Sainte-Clair Deville.—Complete sets of meteorological apparatus have lately been set up at Tongourt and at Biskra, in Southern Algeria, under the author's direction, and the two months' observations now had promise a rich harvest of facts from such deserty stations.

Observations on the Solar Protuberances during the Last Three Months of 1873; Results from use of Gratings Instead of Prisms in Spectral Observation of Protuberances.—P. Secchi.—The solar activity was little. Half-a-dozen spiral spots were observed. The

rotation was verified, but not more than two days, after which it disappeared. The co-existence of spots with eruptions at the sun's border was verified eighty-nine times; only eight times were spots seen at the border without eruption. The reversed lines observed in eruptions were the line intermediate between B and C, the lines D', D'', the lines *b* of magnesium, a large number of the lines of iron, the ordinary lines of hydrogen, and the line D₃. The spiral movement, rare in spots, was several times noticed in protuberances, and not unfrequently a rotation about a horizontal axis. An important observation on Jan. 23, 1874, is given by the author in detail (with figures). "I shall not pass the limit of facts in saying that this spot was the product of an eruption which commenced in a tumultuous manner in the morning, formed in developing-jets whose summits we saw, and that the matter of the eruption falling back to the sun, and being interposed between the observer and the photosphere produced the spot. This observation confirms our theory, and throws much light on the phenomenon." P. Secchi speaks in high terms of the advantages from use of some interference gratings given him by Mr. Rutherford when in Rome.

Refraction of Gases.—M. Mascart.—The author describes an ingenious method of measuring this. The refraction of gases being very weak, at least in the conditions in which it is possible to operate, the refractive power $n^2 - 1$ is sensibly double the difference $n - 1$, or excess of refraction. He finds that, at constant temperature, the excess of refraction of a gas is nearly proportional to the density. He also gives a table of the values obtained for several gases with variations of temperature not exceeding 40°. It appears that the refractive power diminishes, in general, more rapidly than the density.

Geometrical Demonstration of Some Theorems by means of the Consideration of a Rotation Infinitely Small.—M. Mannheim.

Apparent Orbit and Period of Revolution of the Double Star η of the Crown.—M. Flammarion.

Mode of Production of Several Induction Currents.—M. Gaiffe.—The author made a series of experiments suggested by some curious phenomena observed in the gas-lighting by electrical method of the National Assembly hall.

Influence of Albumenoid Substances in Electrical Phenomena.—M. Onimus.—M. Becquerel has shown that when two heterogeneous liquids are separated by an organic membrane or by a capillary space, they give an electric current capable of producing chemical and mechanical effects, reduction of metals, and double decompositions, &c. The author finds that the interposition of a layer of albumenoid matter (white of egg, albumen of blood) has the same electro-chemical results. Thus, with solutions of sulphate of copper and of oxalate of potash separated in a tube by albumenoid substance, beautiful blue crystals of oxalate of copper and potash are obtained. The phenomena, he points out, may throw light on the formation of phosphate of lime in animals. This is obtained in the U tube when the two liquids used are phosphate of soda and nitrate of lime, or chloride of calcium. Again, M. Cl. Bernard has shown that all salts of iron passing through the system are transformed by way of deoxidation or passage to the state of proto-salt. Now the same transformation occurs when perchloride of iron and red prussiate of potash are in contact with albumen in the tube. The perchloride is changed into the protochloride.

New Researches on the Physiological Exhaustion of Beer-Yeast, and Remarks on a Recent Communication by M. Schützenberger on the Same Subject.—M. A. Béchamp.—A "reclamation of priority;" the author maintaining that the recent paper of M. Schützenberger confirmed his previous results.

Action of Chloral on Albumen.—M. H. Byasson.—The author controverts the view of M. Personne that

chloral enters into combination with albumen. He maintains that the urine of persons who have taken chloral hydrate has only a very slight reducing action upon cupropotassic liquid.

Bulletin de la Societe Francaise de Photographie,
No 12. 1873.

At the meeting of the Society, December 5, M. Sutton sent four proofs obtained by one of the procedures described in his "Theoretical and Practical Studies" now in course of publication in the *Bulletin*. The collodion was his ordinary bromo-iodised kind, containing 1 grm. bromide of cadmium to 140 c.c. of collodion. The bath was 7 per cent. The plates were then washed to remove every trace of free nitrate of silver, and covered with a hygroscopic coating composed of—Albumen, 1 vol.; glycerine, 1 vol.; water, 2 vols. They were never dried; prepared in the morning, and developed in the evening with pyrogallie acid to which some drops of nitrate of silver had been added.

M. Buyron, of Lyon, communicated a new mode of preparing collodio-bromised emulsion. He seeks to imitate in the preparation of the emulsion that which takes place when a collodionised plate is sensitised. He prepares a bromised collodion as follows:—

Alcohol at 40°	..	35 cc.
Ether	.. ..	35 "
Gun-cotton	.. ..	1 grm.
Bromide of cadmium		3.5 grms.

After standing for eight days it is poured into a wide-mouthed flask, and evaporated with agitation so that no pellicle may form on the surface. The evaporation is continued till the mass ceases to flow, and does not allow any liquid to drain out of it. On the other hand, 3.5 grms. of nitrate of silver are dissolved in 30 c.c. of alcohol at 36°. The filtered solution is placed into a flask large enough to contain, in addition, the jelly just obtained, which is broken up with a bone spatula, and added to the silver solution in small portions. The mixture is left to react for two or three days. At the end of this time the bromide of cadmium is completely transformed into bromide of silver. The fragments are then again broken up, the alcohol is decanted off, and replaced by 30 c.c. of fresh alcohol at 36°, which is allowed to remain for two or three days longer. This alcohol is then poured off and added to the former. The gelatinous mass remaining is mixed with—

Alcohol at 40°	..	40 c.c.
Ether	.. ..	60 "
Gun-cotton	.. ..	0.2 gr.

and shaken up till completely dissolved. After standing five or six hours nine-tenths are decanted off and preserved for use.

M. Monckhoven has published in the *Rivista Fotografica* a paper on the collodion most suitable for landscapes. He considers an iodised collodion preferable to a bromised.

Two New Preservative Substances Employed in the Dry Collodion Process.—M. de Saint Florent.—These two substances are ratanhia and Sydenham's laudanum. Ratanhia is an extract from the root of *Krameria triandra*, a polygalaceous plant, growing in the Antilles and in Peru. It is rich in tannin, and when employed in the proportion of 10 parts of the aqueous extract to 100 of water, and 10 to 20 of alcohol, it forms an excellent preservative. It is best used with a strongly bromised collodion. The laudanum gives still better results; the proofs obtained with it are very harmonious, and present remarkable gradations of tints. Its properties seem due to the presence of morphia.

Development of Carbon Proofs by the Aid of Metallic Plates.—M. Gobert.

Theoretical and Practical Studies.—M. Th. Sutton.—A continuation of the series of papers commenced by this author some time back.

Reimann's Farber Zeitung, No. 6, 1874.

This number contains a continuation of the article on dyeing vat-blues by G. Leuchs; a receipt for an aniline-violet on cloth or flannel, in which 2 lbs. sulphate of magnesia and $\frac{1}{4}$ lb. sulphuric acid are recommended to 10 lbs. of the goods. The same directions, with merely an alteration in the aniline colour, are given for an aniline-blue, with which sulphuric acid certainly agrees much better than with a methyl-violet. Next follows a continuation of the paper on the manufacture and dyeing of shoddy.

New Red Colour.—The *Musterzeitung* professes to have received a "new red colouring matter from a firm in New York." A swatch dyed with this "new colour" fell into the hands of Dr. Reimann, and on examination proved to be dyed with cochineal!

Signification of Colours.—The *Moniteur de la Teinture* inserts an article by the French poet Gozlan, in which he associates all emotions of the soul with different colours. Thus compassion is light blue; resignation, pearl-grey; joy, apple-green; satisfaction, the colour of caffè au lait, &c.

Clearing (Avivage) of Turkey-Reds Obtained with Artificial Alizarin.—Dr. Armand Müller.—If eau de Javelle or the hypochlorites of magnesia and tin are employed, and the goods afterwards passed through "sours," consisting of a mixture of sulphuric and nitric acid, the red becomes more fiery and inclines more to an orange.

Aniline-Blue on Garments (Cotton Warps).—Work in a clear decoction of 2 lbs. sumach, in which $\frac{1}{4}$ lb. of Marseilles soap has been dissolved; let them lie in the liquid over-night, lift, and soak for six hours in red liquor at 2° B. Aniline-blue, of as green a shade as possible, is dissolved in water, allowed to cool, the solution filtered and used for the dye-beck, with the addition of one-tenth of the spent red liquor. Begin to dye cold, raise the temperature slowly, and finish at a boil. Lift, rinse, pass through gum tragacanth, and finish.

Rosenstiehl has patented a machine for straining printers' colours by the pressure of the atmosphere.

MISCELLANEOUS.

Metropolis Gas Acts.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has recently submitted his quarterly report to the Corporation of London and the Metropolitan Board of Works on the quality of the gas supplied during the months of January, February, and March by the Chartered, the Imperial, and the South Metropolitan Gas Companies; from which it appears that the average illuminating power of the Chartered gas at the different testing-places has been as follows:—Beckton, 17'31 standard sperm candles; Cannon Street, City, 17'01 candles; and Friendly Place, Mile End, 17'38. The average power of the Imperial gas has been 16'81 candles at Carlyle Square, Chelsea; 16'04 candles at Camden Street, Camden Town; and 16'61 candles at Graham Road, Dalston; while that of the South Metropolitan gas at Hill Street, Peckham, has been 16'61 candles. These results are above the requirements of the several Acts of Parliament. With respect to purity Dr. Letheby reports that the gas of all the Companies has been constantly free from sulphuretted hydrogen, and that the average amounts of sulphur in other form than this has been 13'67 grains per 100 cubic feet of the common gas at Beckton, 14 grains per 100 feet at Cannon Street, 11'02 grains at Friendly Place, 23'54 grains at Millbank Street, 18'67 grains at Ladbroke Grove, 17'95 grains at Carlyle Square, 20'68 at Camden Street, 19'86 grains at Graham Road, and 26'93 grains at Hill Street, Peckham. The proportion of sulphur has been in excess of the prescribed quantity on one occasion at Beckton, on one occasion at Carlyle Square, and on nine occasions in the South Metropolitan gas at Hill Street, Peckham. Most of these have been the subjects of appeal

under the provisions of the Acts of Parliament, and the Chief Gas Examiner, having enquired into them, has certified that they have arisen from unavoidable and accidental causes. The proportion of ammonia in the gas at all the testing-places but one has never exceeded the prescribed quantity of 2'5 grains per 100 cubic feet of gas. At Ladbroke Grove, however, the cannel gas of the Chartered Company has on 19 occasions contained an excess of this impurity. The illuminating power of the cannel gas of the Chartered Company has averaged 21'45 candles at Millbank Street and 21'50 candles at Ladbroke Grove.

Glasgow Veterinary College.—Dr. R. Carter Moffat, Professor of Chemistry, has left England to carry out an extensive series of experiments in Southern Italy. He proceeds to the great alpine district of the Santa Liberata and Valley Romana, where enormous deposits of bitumen, sulphur, and lignite exist. We wish him a successful journey.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of gas for heating and illuminating and in the utilisation of residual products of the said manufacture John Hinks, manufacturer, and Henry Holland, tool-maker, Birmingham. June 9, 1873.—No. 2047. In manufacturing gas according to this invention, caoutchouc or other solid hydrocarbon is dissolved in benzoline or other volatile liquid hydrocarbon and caustic alkali, or alkaline earth and water are added. This mixture is heated in a generator, and the gas evolved conducted first into a heated receiver, and afterwards into a chamber containing trays filled with benzoline or other volatile liquid hydrocarbon. From this chamber the gas enters a receiver, in which it is mixed with about three times its volume of atmospheric air. When the gas is about to be used, it is passed through a chamber containing trays of liquid volatile hydrocarbon into the delivery-pipes. The oily liquid condensed in the pipes and receivers is purified with lime or otherwise, and may be burned in lamps used for burning light oils.

An improved mode of treating sewage- and other contaminated waters. John Leigh, Manchester. June 11, 1873.—No. 2071. For the purification of sewage- and other contaminated waters, there is added thereto, in suitable vessels with agitation, a solution of an earthy salt, and afterwards a solution of silicate of soda or of potash, whereby a precipitation or subsidence of the suspended matters in the sewage- or other waters is produced. Of the earthy salts, it is preferred to use a solution of alum or of sulphate of alumina, of sulphate or of muriate of magnesia, or of muriate of lime. Should the sewage- or other water, after being thus treated, contain any gelatinous or albuminous matters in solution, or afford evidence of other organic matter in solution, it is preferred to add a small quantity of a solution of tannin or of some solution containing tannin thereto.

Improvements in the production of chromic acid, compounds containing chromic acid, and certain other compounds of chromium. Desmond Gerald Fitz-Gerald, electrician, 6, Loughborough Road North, Surrey, and Bernard Charles Molloy, barrister-at-law, 1, Elm Court, Temple, Middlesex. June 13, 1873.—No. 2102. This Provisional Specification describes a process for obtaining chromic acid from bichromate of potash. The Provisional Specification also describes various chemical processes relating to the production of compounds of chromium.

Improvements in the construction and working of voltaic batteries. Desmond Gerald Fitz-Gerald, electrician, 6, Loughborough Road North, Surrey, and Bernard Charles Molloy, barrister-at-law, 1, Elm Court, Temple Middlesex. June 13, 1873.—No. 2103. This Provisional Specification describes a voltaic couple in which the negative element divides the cell into two compartments. One compartment contains the positive element, and the other a solution capable of oxidising nascent hydrogen. The Provisional Specification also describes other improvements in voltaic batteries.

Improvements in the manufacture of manure. Edward Charles Hamilton, Camp House, Colchester, Essex. June 14, 1873.—No. 2114. The object of this invention is to manufacture manure in a dry powdered condition from fish, more especially from the Uraster Rubens, commonly called a five-finger, or from star-fish. The fish are first pulped, then dried, and afterwards reduced to powder.

Improvements in the manufacture of cements, plastic and pulverised compounds, combined with chemical and other materials, suitable for being employed in the production of plain and ornamental slabs, moulded and other objects and surfaces, architectural concrete and other structures to which such cements and compounds are applicable, and in the means and apparatus employed in such manufacture; also in treating surfaces, objects, and structures preparatory to applying such cements or compounds or other cementitious materials thereto. Edwin Robbins, designer and modeller, Figtree House, Wedmore Street, Holloway, Middlesex. June 16, 1873.—No. 2116. According to this invention, cement and composition are made by pulverising crude half-burnt or burnt carbonate of lime, baryta, strontia, magnesia, zinc, or any other suitable carbonate separately or combined with each other, or combined with other materials of any description, calcareous or argillaceous. In combination with the above, every description of material—animal

vegetable, or mineral—is employed. For example, as one illustration, sand, gravel, siliceous stone dust, glass, mail, clay, lime, or any other such material is submitted to a solution of silicate of soda, potash, soluble silicate, gum, glue, or any of the animal, vegetable, or mineral gums in any convenient form or rotation, separately or combined. When sufficiently dry or concentrated, it is then ready for use. The carbonate of lime is mixed with dilute muriatic acid. After standing a sufficient time, they are mixed together with the prepared gritty or other materials in proportions varying from 1 part of lime to 4 parts of sand, or 1 part of lime to 40 or 50 parts of sand, according to the density, quantity, and proportions relatively of the silicate, gum, glue, and gelatin; bitumen, or any other animal, vegetable, or mineral gums are applied in any convenient form.

An improvement in the preparation of spirits, wines, and other fermented liquors. David Ker, William Street, Lowndes Square, Middlesex. June 16, 1873.—No. 2123. The object of this invention is, first, to soften new and fiery spirits and to improve their flavour, while at the same time they are rendered comparatively innocuous to the coats of the stomach; and, secondly, to preserve light wines, such as clarets, and other fermented liquors from turning acid. These results I attain by combining with such liquids the substance commonly known as glycerin.

A new or improved vulcanisable waterproof gum, and process for producing the same. Benjamin Joseph Barnard Mills, patent agent, of the firm of Harris and Mills, 35, Southampton Buildings, Middlesex. (A communication from Daniel Martin Lamb, machinist, Strathroy, Middlesex, Ontario, Canada). June 17, 1873.—No. 2126. The subject of this invention is a vulcanisable waterproof gum, produced from the inspissated juice of plants of the asclepias or milk-weed family, or other plants possessing like properties, or from flax or other analogous seeds.

An improvement in the manufacture of hydraulic cements. Alexander Bennett McGrigor, solicitor, Glasgow, Lanark, N.B. (A communication from James Moeller Robertson, architect, Melbourne, Victoria). June 19, 1873.—No. 2147. This invention substantially consists in making a strong hydraulic cement by the mixing of one or other of the known simple infusorial limestones of the oolitic and other geological periods in a powdered state, with a proportion of any of the nearest well-known simple basalts of the basaltic formation and periods, both in their natural state, the proportion of the two to be mixed being easily found by trials depending mainly on the nature of the basalt used, which the inventor has found by examination contains the necessary ingredients for making such a water-cement, without the separation of substances thereto or from, as is necessary in the ordinary processes of making these cements from various limestones, chalks, and clays. The inventor has thus found that these substances do not materially vary in their composition, so that he is enabled to make a portland hydraulic cement by their mixture, which he claims as his invention, substantially as described.

NOTES AND QUERIES.

Determination and Estimation of Anthracen.—Will some reader kindly answer the following:—What is the most simple and accurate method of determining and estimating the quality of anthracen after being pressed, washed, and re-pressed? What work on chemistry gives most information relative to coal-tar products.—STUDENT.

Estimation of Nitrogen.—(Reply to "Student.")—"T." in addition to advising the use of the troublesome method of Dumas for estimating the total nitrogen, overlooks the fact that Varrentrap and Will's method yields some of the nitrogen of the nitrate as ammonia, especially if some kinds of organic matter be present (*Chem. Soc. Journ.*, [2], xi., 1161). In fact, Fresenius, who is referred to for the details, directs that the total nitrogen in manures, containing it in the three forms, should be estimated by Varrentrap and Will's method. Fresenius then advises the use of Schlösing's methods for estimating the ammonia and the nitric acid. E. Hunter assumes that the nitrogenous organic matter will be insoluble in water, which is, by implication, denied by Fresenius, who, in recommending Schlösing's method of estimating nitric acid in manures, says that it is particularly applicable in the presence of organic matter, from which "the [aqueous] solution will scarcely ever be free." If "Student" simply desires to know the total nitrogen present in the three forms I should recommend the method given by me in the CHEMICAL NEWS, vol. xxv., page 205.—B. J. GROSJEAN.

Notes on the Utilisation of Sewage.—(From the "Report of the Main Drainage Committee for 1864," vol. 487).

4882. (Professor Way.) Sewage contains so large a quantity of carbonic acid that when you put lime in it carbonate of lime is formed. The object is to produce a precipitate, which, in going down, shall take those flocculent matters.

4901. Do you know what the plan which is pursued at Leicester is?—Yes; I have seen it.

4902. Is that a successful experiment?—It has been a tremendous failure as a money speculation.

4903. Is that undertaken by the town?—No; it was undertaken by a company at a cost, I think, of something like £60,000. They made large quantities of solid manure, by precipitation by lime, and they succeeded in selling some of it at first, but, generally speaking, they sold it to fresh customers every time; that is to say, a man used it, and then would not buy any more; and now they can only sell it at 2s. per ton.

4914. (To the same.) You state that clay is the best deodoriser; have you ever turned your attention, or do you know much of Bagshot Heath, and Woking, and those districts?—I know that district very well.

4920. In all our analyses of the sewage water we have found a quantity of insoluble matter of the nature of clay amongst the other insoluble matters, and I believe that at Edinburgh now the soil has to a great extent become a different soil from what it originally was; by that means it would be perfectly practicable to pump a little suspended clay on with every gallon of water, if you were doing it on a large scale, and it would be only a trifling increase of expense, because clay, when once suspended in water, subsides with great difficulty.

4922. (To the same.) As the sewage progressed it would require clay for the purpose of deodorisation?—Yes.

4962. I say that if a man owes me the value of an ounce of gold, £4 15s., and if he comes and gives me a ton of quartz, and says "there is an ounce of gold in this ton of quartz," it is not paying me. That is precisely the condition of the sewage.

5015. (To Mr. Congreve.) Do you mean to say that greater crops are not procured by means of the application of sewage?—Greater crops are procured, but they are of a much worse quality, the land grows a greater quantity of grass, but that grass is not of the same value as the grass that grew there before.

5025. What is your opinion of the large quantities of sewage that Mr. Lawes has applied; has it made the land worse?—I believe it has.

5026. Since Mr. Lawes has applied sewage the land is not nearly so good as when it was in Mr. Walker's hands?—Certainly.

5027. Do you mean to say, also, it was in worse condition when Mr. Walker gave it up to Mr. Lawes than when Mr. Walker received it?—No; because one piece had not been sewaged before Mr. Lawes took it in hand, and the result ought not to go forth as the result of the application of sewage; that land was thoroughly drained and manured before he began, and it would have produced much better crops before the sewage was applied to it. Therefore Mr. Lawes's results are complicated results, and the results of good management previously.

5028. (To the same.) Was not the land sewaged before Mr. Lawes took it?—Not that one piece.

5030. Is the most sewaged piece the worst of the three?—I should say it is, decidedly.

5045. Are you of opinion that the application of sewage would be actually injurious instead of being beneficial to the land?—Some of the land at Rugby was good feeding land previous to the application of sewage, and the sewage being applied to that land certainly deprived it of its feeding powers; feeding land is at present the most valuable land that we have.

5047. If applied to fallow land would it not grow corn well?—No; you get no corn from it; you get a large quantity of straw and coarse corn, but there is scarcely any wheat from it.

5053. Do you consider that it is a failure?—I do not know at all, it is such a varied question. Mr. Lawes shows that sewage will produce a very great quantity of grass, but he does not say anything of the quality of the grass.

5056. (To the same.) Does it destroy the finer grasses?—Yes; it destroys the finer grasses and encourages the coarser ones. As an instance of that I may say that the hay from a field which, before the sewage was applied was one of the best fields in the neighbourhood, a little while ago was worthless.

5068. Do you consider the land at Rugby to be over-tilled by the sewage?—The finer grasses have been destroyed and the coarser ones stimulated.

5082. How often was it applied in the year?—Four or five times.

5083. Did it destroy the fine grasses?—Yes, decidedly.

MEETINGS FOR THE WEEK.

MONDAY, 27.—Medical, 8.

— Society of Arts, 8. Cantor Lectures.

— London Institution, 4.

— Geographical, 8.30.

— Philosophical Club, 6. Anniversary.

TUESDAY, 28.—Civil Engineers, 8.

— Anthropological, 8.

— Royal Institution, 3. Prof. Rutherford, "The Nervous System."

— Society of Arts, 8. Col. J. C. Gawler, "On the History, Progress, and Prospects of South Africa."

WEDNESDAY, 29.—London Institution, 12 a.m. Anniversary.

— Society of Arts, 8.

— Zoological, 1 p.m. Anniversary.

— Geological, 8.

THURSDAY, 30.—Royal Institution, 3. Mr. W. N. Hartley, "On the Atmosphere."

— Royal, 8.30.

— Royal Society Club, 6.

FRIDAY, May 1.—Royal Institution, 2. Annual Meeting.

— Royal Institution, 9. Prof. Rolleston, "Early Inhabitants of North of England."

— Society of Arts, 8. Mr. H. G. Kennedy, "Ruins of Cambodia and the Antiquities of Indo-China."

— Geologists' Association, 8.

SATURDAY, 2.—Royal Institution, 3. Prof. Seeley, "Age of French Revolution."

TO CORRESPONDENTS.

H. Cant.—In a few weeks.

K. I. K.—Calc-spar and Iceland-spar are the same thing. They can be obtained from any dealer in minerals.

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CHEMISTRY APPLIED TO THE DETECTION OF ADULTERATION.

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(Continued from p. 169.)

II. TEA (*continued*).

SINCE the first part of this article was printed, I have submitted the same set of samples of purposely adulterated tea (described on page 168) to another tea-taster of great experience, who formed the following opinions as to their purity:—

No. 1.—Very poor; contained many exhausted leaves. Ranked 5th.

No. 2.—Passed pure. Ranked 1st.

No. 3.—Would have been the best, but lacks strength, and is therefore suggestive of exhausted leaves. Ranked 3rd.

No. 4.—Not pure, but very slightly adulterated by exhausted leaves. Ranked 4th.

No. 5.—Passed pure, and ranked 2nd.

Estimation of Tannin, &c., by Lead.—Five grammes of lead acetate are dissolved in water and diluted to 1 litre, and the solution filtered after standing. The indicator is made by dissolving 5 milligrammes of pure potassium ferricyanide in 5 c.c. of water, and adding an equal bulk of strong ammonia solution. One drop of this test will detect 0.001 milligram of tannin, or 1 milligram dissolved in 100 c.c. of water.

The precipitating power of the lead solution is ascertained by diluting 10 c.c. of it to about 100 c.c. with boiling water, and adding to it, from a burette, a solution of 0.1 gram of pure tannin in 100 c.c. of water. After adding 10 c.c. of the latter solution, about 1 c.c. of the liquid is withdrawn with a pipette and passed through a small filter, the drops being allowed to fall on to spots of the indicating solution previously placed on a porcelain slab. If no pink colouration is observed, another small addition of the tannin solution is made, a small portion of the liquid filtered, and added to the indicator as before, the process being repeated until a pink colour is observed. The greatest delicacy is obtained when the drops of liquid from the funnel are allowed to fall directly on to the spots of indicator, instead of observing the point of junction of the liquids.

The reaction being complete, a second estimation is made, and in this case almost the full volume of tannin solution can be added at once.

It is necessary to use the purest tannin for the purpose, as a serious error may otherwise occur, some samples of commercial tannin having little more than half the precipitating power of the best.

Exactly the same process is employed for estimating the tannin in tea, the decoction being substituted for the standard tannin solution and added to the lead solution as before.

The solution of tea is prepared by boiling 2 grms. of the finely-powdered sample with about 80 c.c. of water for half an hour. The decoction is strained through fine muslin, the particles of leaf returned to the flask, and the boiling resumed for an hour with the same quantity of water as before. The process is repeated till no more colouring matter is extracted. The whole of the solution is set aside, to allow any particles that may have passed through the muslin to subside, when the liquid is decanted from the sediment, the last portions passed through a

filter, and the whole decoction made up to 250 c.c. This diluted solution is ready for use in the burette, the remainder of the process only occupying a few minutes.

The volume of tannin, or tea solution, it is necessary to add to 100 c.c. of pure water, in order that a drop may give the pink reaction with the ferricyanide is subtracted from the total amount run from the burette.

If the solutions are made of the strength here described, 10 c.c. of the lead solution will precipitate about 10 milligrams of pure gallotannic acid, and therefore the volume of tea solution added contains 0.01 gram of tannin.

If all the weights and volumes above mentioned are observed, 125, divided by the number of c.c. of tea solution used, will give the percentage of tannin, &c., in the sample.

We have ascertained that prolonged boiling does not affect the precipitating power of the tea, and solutions of the same sample prepared on different occasions have given absolutely concordant or closely agreeing results. The percentage of tannin in tea can be ascertained by this process to within 0.2 per cent.

The results obtained by this method agree fairly with those recently obtained by Mr. Bell by the gelatin process, as will be seen from the following figures:—

Tannin in Genuine Black Tea.

	By Gelatin. (Bell.)	By Lead. (Allen.)
	Per cent.	Per cent.
Highest amount	12.00	11.6
Lowest amount	9.50	8.5
Average of 8 samples ..	10.97	—
Average of 28 samples ..	—	10.0

Even after infusion tea-leaves still retain a sensible quantity of tannin, which varies from 1 to 4 per cent, according to the extent of the previous treatment. The usual amount is about 3 per cent. Taking the tannin in fresh tea at 10 per cent, and in exhausted leaves at 2 per cent, the extent to which a sample is adulterated would be found approximately by the following equation, in which E is the percentage of exhausted leaves, and T the percentage of tannin found:—

$$E = \frac{(10 - T) 100}{8}$$

We have not examined many green teas by the lead method. The tannin found in genuine specimens varies considerably, 20 per cent being about the usual amount. The estimation is of less importance than with black tea, as green tea is very unlikely to be adulterated either with exhausted leaves or foreign tannin matters.

Insoluble Matter.—When tea in its commercial condition is boiled repeatedly in fresh quantities of water till the liquid no longer becomes coloured, the residual leaves, when thoroughly dried, weigh about 50 per cent of the original tea, if green, and about 60 per cent if black. A very large number of estimations of insoluble matter have been recorded, and in no case has a genuine tea yielded a higher percentage than 60.12, which was obtained by Mr. J. Bell from an inferior congou tea. In the accompanying tables I give a number of analyses of genuine teas, from which it is evident that the proportion of insoluble matter is very constant, even in teas of very different qualities.

Having noticed that in broken teas the insoluble matter was sensibly less than in unbroken, we tried the effect of exhaustion by repeated boiling with water on various genuine teas previously reduced to powder. By this method the percentage of insoluble residue is still more constant, but about 8 or 10 per cent lower in each case than is obtained by treatment of the whole leaves. Thus genuine green teas gave an average of 42.0 per cent, the highest amount being 45.0 per cent, and the lowest 39.0 per cent. In black teas the lowest gave 46.7 per cent, and the highest 53.6 per cent, the average of thirteen samples being 49.0 per cent.

It is impossible to insist too strongly on the importance of estimating the insoluble matter on the *pounded* tea, not

on the whole leaves, for not only is the soluble portion more readily and completely extracted, but the serious error involved in the examination of broken teas is avoided, and the results obtained from such samples can be fairly compared with the rest.

The insoluble matter is most conveniently estimated by drying the residue left after filtration of the tannin solution at about 120° C. till the weight is constant. When the process is repeated on the same tea, the results agree extremely closely with the previous estimation, rarely showing a difference of 0.5 per cent.

The estimation of insoluble matter is of great importance as a means of forming an opinion as to the presence or absence of exhausted leaves.

The percentage of insoluble matter contained in previously infused black tea leaves, after being air dried, varies from 78 to 85 per cent. These results are upon the whole leaves. When the estimation is made on the previously pounded tea the insoluble matter varies between 72 and 75 per cent.

Gum.—It is occasionally desirable to estimate the percentage of gum in tea. Infusion in water of course removes most of the gum. Caper teas and exhausted leaves often contain excess, owing to an addition of gum during their preparation. The gum is determined by evaporating the aqueous decoction of the tea almost to an extract, treating the residue with methylated spirit, and filtering and washing with spirit. The gum is rinsed off the filter with hot water, and the solution evaporated at a steam-heat, and the residue weighed, ignited, and weighed again. The loss represents the gum. If the ignition is omitted the results are too high, owing to the presence of mineral matter.

Soluble Ash.—The percentage of ash soluble in water is also a valuable independent indication of the presence of exhausted and foreign leaves. In the following table I give the percentage of soluble ash contained in a number of samples of genuine tea in exhausted tea-leaves, and in the dried leaves of various other plants:—

	Total Ash.	Soluble Ash.	Authority.
Coffee leaves	10.32	3.77	A. H. Allen.
Beech	4.52	2.00	J. A. Wanklyn.
Bramble	4.53	1.84	" "
Raspberry	7.84	1.72	" "
Hawthorn	8.05	3.78	" "
Willow	9.34	4.16	" "
Plum	9.90	5.66	" "
Elder	10.67	3.19	" "
Gooseberry	13.50	7.83	" "
Common tea	5.92	3.55	" "
Paraguay tea	6.28	4.22	" "
Average of seven teas	5.75	—	" "
Average of nine teas of commerce	5.66	3.00	A. S. Wilson.
*Horniman's pure black	5.30	3.50	A. H. Allen.
*" " " green	5.60	3.80	" "
*"Ambrosial" black tea	5.60	3.40	" "
*Genuine black at 2s.6d.	5.60	3.09	" "
*" " " "	5.70	3.28	" "
*" " " "	6.02	3.26	" "
*" " " "	6.34	3.20	" "
*" " " "	6.10	3.96	" "
*" " " "	5.75	3.06	" "
*" " " at 3s.	5.50	3.55	" "
Broken leaf, with stalks	5.40	2.80	" "
Caper (containing 4.8 siliceous matter) ..	11.40	1.50	" "
Mixed dry exhausted leaves from various teas	4.30	0.52	" "

The soluble ash is determined by evaporating the aqueous solution of the ash, and gently igniting the residue, which must be cooled under a desiccator. The

mean total ash of the teas marked with an asterisk comes to 5.75 (the same as Wanklyn's mean), and the soluble ash to 3.34, and it will be seen that the latter constituent is scarcely ever below 3.00, while exhausted tea-leaves contain only 4.3 of total and 0.52 of soluble ash. When no foreign leaves are present we are therefore fully justified in calculating the probable proportion of exhausted leaves by the following formula, in which E is the percentage of exhausted leaves, and S the percentage of soluble ash:—

$$E = (6 - 2S)20.$$

Of course the result can only be considered as an approximation to the truth, but when the proportions of soluble ash, tannin, and insoluble matter agree in proving the presence of previously exhausted leaves, a very fair conclusion can be arrived at as to the extent to which the adulteration had been practised.

(To be continued.)

ON COMMERCIAL ANALYSES.*

By E. C. C. STANFORD, F.C.S.

THE attainment of accuracy in the methods employed in the valuation of commercial products is becoming daily more important. It is not my intention in this paper to refer to adulterations strictly so-called, but merely to the valuation of the large class of chemical products sold only by analysis. The number of samples passing through the hands of the analytical chemists of Glasgow alone must be enormous; and, although I can bear strong testimony to the remarkable accuracy with which these analyses generally are performed, there are often disputes with other chemists employing different methods, and then we feel the want of certain standard processes of sufficient authority to appeal to.

Chemists who do not employ exactly the same methods almost always differ in reporting the strength of a given sample, especially where there are several bases and acids present, and particularly if the separation of these is difficult. But even those who may happen to employ the same method in these cases, and may attain the same results, often differ so widely in the statement of those results, that their analytical figures look like those of different substances. The custom with some analysts of making their figures up to 100, and thus giving the analysis the *appearance* of being complete, and *perfectly* accurate is highly to be deprecated. The analysis should be always given as the figures come out, and, if the analyst is in any doubt as to the way in which the acids and bases are combined, the amounts of these should also be stated separately.

Now that all large chemical works are obliged, for their own guidance and protection, to have a thorough analysis of all they consume and produce, it is not sufficient to know that a carbonate of potash or soda contains a certain percentage of alkali; we must know also which alkali it is, and what acids it is combined with.

Here, again, the want of uniformity produces confusion. I shall only select a few simple examples of differences in processes, and then consider the effect of different statements of results, and afterwards suggest what appears to me to be the only remedy. I shall allude only in this paper to superphosphates and potash and soda salts.

Superphosphates.—There are few products more in dispute than those containing phosphates of lime. I heard of a case some time ago in which samples of a cargo of coprolites, guaranteed 62 to 63 per cent, were drawn and sent to four chemists, all eminent. One made the strength 56 per cent, another 57 per cent, another 58 per cent, and the other 62 per cent—the latter being right. Putting the value at £3 10s. per ton, or, say, 1s. 2d. per unit, there was a difference in value of 7s. per ton between the highest

* A Paper read before the Glasgow Philosophical Society, Chemical Section.

and lowest, and any broker buying by the latter and selling by the former would make a profit of £35 on the 100 ton cargo. This would be about 10 per cent, a pretty good brokerage, and enough to induce him to retain a "low chemist" permanently on the establishment. As there are computed to be about 200,000 tons of mineral phosphates raised in Great Britain alone, this difference would be equal to about £70,000 per annum—an ample margin for anyone who likes to trade on scientific weakness.

Mr. James Napier in a paper read before this Society in 1870,* speaking from an experience of over two hundred analyses of phosphate, says that the discrepancies between different chemists was generally from 2 to 3 per cent, and sometimes 5 per cent. He mentions one case of a sample of dissolved bone-ash sent to four different analysts, whose results varied from 41 to 47 per cent,—44 per cent being correct. He also mentions one analysis of bone-ash in which 9.5 per cent of phosphate of magnesia was reported as an ingredient. Where iron and alumina are present, the differences in the estimation of the insoluble phosphates are often considerable. One well-known chemist reported a sample of superphosphates from coprolites after four determinations, of which all gave uniform results of soluble phosphates, but all gave different results in the insoluble; the presence of alumina was the cause of these discrepancies.

There are so many processes in use for the estimation of phosphoric acid in phosphatic materials, and the discrepancies, particularly in coprolites and mineral phosphates, and in the manures made from these, are very considerable.

Some chemists still cling to the inaccurate method of simply precipitating the tribasic phosphate of lime by ammonia, and the precipitate may contain, in addition, everything precipitable by ammonia; it is generally, therefore, too high. Others adopt Fresenius's magnesia method, where, the lime being precipitated by oxalate of ammonia, the iron and alumina are held in solution by citric acid; the phosphates are weighed as ammonio-phosphate of magnesia. This process gives results a little too low. At a convocation of chemists at Magdeburg, held three years ago, it was agreed that, when this process was adopted, it could be made sufficiently accurate by the addition of 0.1 to every 5 per cent of tribasic phosphate of lime found. The convocation, however, agreed that the best, although the most tedious method, was by precipitation as phospho-molybdate of ammonia, and subsequent conversion into ammonio-magnesian phosphate, and, finally, by ignition into di-magnesian phosphate. I quite agree with Warrington that the phosphate should always be acted on by cold water in the first instance. The presence of alumina in this solution will, however, produce a precipitate of phosphate of alumina on boiling, and in this case a cold solution will show more soluble phosphates than a boiling solution. In some instances where alumina is not present, it is recommended to precipitate the phosphoric acid as phosphate of uranium. Mr. Ogilvie, in a paper read before this Section in 1872, gives a good process for the general analysis of phosphates containing iron and alumina.†

Potassium Salts.—There is often considerable discrepancy in the total amount of potash reported by different chemists. It is chiefly observed in the comparative results of German and English chemists, and also between the latter and our local chemists. It probably arises from the use of alcohol in addition to platinum chloride, whereby a portion of the soda salt is not unfrequently thrown down and weighed with the potassium salt; others digest with a large excess of strong platinum chloride solution, without alcohol, in which the potassium

salt is quite insoluble, while the soda salt is freely dissolved. Alcohol is used only to finally wash the precipitate. In a perfectly pure potash salt free from soda, the former process may give accurate results, but, when soda is present, the differences in the two processes may range from 1 to 2 per cent of potash, and have been known to be sometimes 5 per cent.

It is to be noted that a complete analysis of the mixed salts affords little check on the potash result, as, if the estimate be too high—in the case of muriate, for instance—a portion of the chlorine will have to be withdrawn for it; this would otherwise have been calculated as chloride of sodium, a few per cent of which will thus substitute chloride of potassium, and make up an apparently accurate analysis.

Mr. Tatlock introduced the use of platinum chloride solution instead of alcohol in an excellent paper read before this Society in 1868, and before that time there was considerable difference in the potash results of our local analysts, which have not occurred since that process was published. In our own works, where a large number of potash determinations are made every week, we invariably employ this process, and find it perfectly accurate. Indeed, whenever we examine the same samples as Mr. Tatlock, we find most concordant results, and I know of a case where his accuracy was tested, in a dispute with a German chemist, in a way which he now hears for the first time. A carefully-prepared mixture of pure salts of potash and soda was sent to him, and reported exactly accurate. In the paper referred to, Chalmers and Tatlock show the great importance of using perfectly-pure platinum, and the difficulty of obtaining it; and that ordinary spongy platinum will give a result 2 per cent too high in chloride of potassium. Some other details of manipulation and calculation are given in the paper, which is the best which has yet appeared on the subject, and, if the process is followed as described, I repeat, from long experience, it is rigidly accurate. I speak strongly on this point, because the process was afterwards criticised in the *CHEMICAL NEWS* by Teschemacher and Smith, in which they kindly attributed all the inaccuracies to the chemists of Glasgow, and all the perfect results to their own process, which involves the use of alcohol and its attendant errors. In this paper the authors convict themselves, as in one of their own experiments, undertaken to test the process, they actually show an error of 1.4 per cent of a potash salt. Now, that may be near enough for London, where there are no potash manufacturers, but it would not do for us. In the salt referred to—nitrate of potash—it would make a difference of 8s. 6d. per ton. And yet in a recent letter in reference to this process, Mr. Teschemacher says—"It fell to our lot to examine the validity of the alarming statements these gentlemen had published, when in a memoir on the same subject, to be found also in the same volume of the *CHEMICAL NEWS*, we had the satisfaction of proving that the alarm they had raised was utterly groundless, and that they, in fact, had found a mare's nest. In this memoir of ours we, further, were able to render the service to chemical analysis of describing in detail a more perfect and easier mode of determining potash by platinum than had hitherto been employed, a mode which is now generally adopted by analysts, and incorporated in the recent text-books of chemical analysis." And, further, he does not think that I will deem it requisite to pursue my researches on this subject further, when I have read what he calls "this hitherto-unquestioned memoir."

Statement of Results.—If authorities differ in the processes employed, so do they also considerably differ in the statement of results and reports of analytical values. I repeat here, in the first place, that the figures ought never to be made up to 100. It only shows an apparent accuracy to those who do not understand analysis, and may cover a multitude of sins. To the initiated, it shows that the analysis in many cases *cannot* be accurate. I shall refer again to the same substances, superphosphates and potash and soda-salts.

* Napier, on "The Farmer and the Chemist"—*Proc. Phil. Soc. of Glasgow*, vol. vii., p. 387.

† Ogilvie, "On the Separation of Phosphoric Acid, Ferric Oxide, Alumina, Lime, and Magnesia"—*Proc. Phil. Soc. of Glasgow*, vol. viii., p. 189.

Superphosphates.—The valuation of these important manures is full of confusion. Mr. T. L. Patterson, in a paper read before this Section in 1872,* treated most exhaustively the value of mineral phosphates from what he called a decomposition point of view," and illustrated very clearly the important bearing on the value from the percentage of what Morfit calls "profligate associates." The valuation should bear an inverse proportion to the amount of these. Thus, some mineral phosphates which contain less phosphate of lime may be really more valuable than others which contain more, because it is not combined with "profligate associates." Again, it is obvious that in a very weak manure the chemical value may be far above its actual value in the market, from the large amount of valueless material with which it may be associated. On the other hand, the directors of the various sewage companies assure us that their manures cannot be valued by analysis at all, having some hidden manurial value which only farmers can detect.

I shall not in this paper discuss such a daring assertion; but, taking the ordinary valuations of chemists, it must be admitted that they are apt to adopt certain standards of value without any reference to the actual market value at the time of the various ingredients composing the manure. Hence it often happens that ammonia is valued in a manure at the same rate, though the price of sulphate in the market may vary from £10 to £20 per ton. Then, again, as pointed out by Mr. Napier in the paper before referred to, nitrogen or ammonia, being valued in a manure, no notice is taken of the fact that the nitrogen may exist as shoddy, leather, &c., or as an ammonia salt, the former being actually worth much less than the latter, although the chemical value is put down as the same. Now there should be different values assigned to soluble and insoluble nitrogen, as to soluble and insoluble phosphates. The same remarks apply to phosphates; however these rise or fall in the market, the same arbitrary value is affixed.

Again, except the distinction of soluble and insoluble, no notice is taken of the form in which the phosphate exists. Yet this is a most important point. Most chemists admit that the soluble phosphate of lime is equally valuable, whether it is obtained from animal or mineral phosphate, and most chemists are also agreed that the insoluble phosphate of bones is valuable, while that of mineral phosphate is valueless. Dr. Voelcker, an eminent authority, admits the truth of this, and yet in reporting on the precipitate obtained by the Phosphate Sewage Company (Limited), using Forbes's process, he reports an insoluble phosphate as containing 28.52 per cent of phosphoric acid; now this phosphoric acid, according to his own showing, must consist principally of phosphate of iron and alumina, highly insoluble phosphates, and yet he reports the manure as "equivalent to 62 per cent of tribasic phosphate of lime," and that "it should command a ready sale at £7 7s. per ton."† Forbes, in reporting this result, is evidently a little ashamed of the exaggeration, for he puts the value of the manure at £3 to £5 per ton. It would be interesting to know how much the Phosphate Sewage Company have sold, and at what price. The Company has been in existence a number of years, and from such statements as these the public have been induced to run up its shares to more than five times the amount paid on them. A writer in the CHEMICAL NEWS has three times tried to elicit Dr. Voelcker's explanation of his report, but unsuccessfully; this is much to be regretted, because either the valuation is right or it is wrong, and either Dr. Voelcker has made a mistake and will not admit it, or phosphate of alumina has a manurial value which has not hitherto been assigned to it; and if this be the case, why is it a drug in the market?

With regard to phosphate of lime, we know that much loss is often occasioned to the manufacturer who works mineral phosphates by what is called "going back," or reverting from soluble to comparatively insoluble phosphate of lime; this is now known as "reduced phosphate." There can be little doubt, seeing that all soluble phosphate becomes reduced phosphate when applied to ordinary soils, that this form is quite as valuable to the farmer as the soluble variety. I believe this to be the future form of phosphate, which the farmers will insist on having. It can be made cheaper in proportion, it can be made quite free from "profligate associates" and almost pure, and it is a much more convenient form.

Yet this form of phosphate is not usually valued, and the manufacturers thus lose, while the farmers gain, by chemical analysis. In fact, we have no reliable process by which we can estimate this any more than we can estimate the chemical difference between insoluble animal or mineral phosphate.

This state of things is a discredit to our science. No farmer ought to be able to discover a manurial value which defies the skill of the chemist. I have said enough to show that the analyst should confine his attention to stating the ingredients, and should never be led into their valuation; that is business, not science.

Potassium and Sodium Salts.—Any one who sees a large number of analyses of potash salts containing soda must be struck with the remarkable difference in the statement of results, especially as to the arrangement of the acids and bases. To a certain extent this is arbitrary, but there is no reason why all should not be guided by rules authoritatively fixed. In cases of carbonate of potash the sulphuric acid is often stated as sulphate of soda, and the chlorine as chloride of sodium. I append some instances, taken from the reports of well-known chemists.

Carbonate of Potash.	A.	B.	C.
Carbonate of potash ..	91.44	80.55	79.99
Sulphate of potash ..	0.42	—	—
Sulphate of soda ..	0.34	—	0.71
Chloride of sodium ..	0.98	3.74	1.72
Water	6.82	15.71	15.76
Insoluble matter ..	traces	—	0.04 silica. 1.78 carb. soda.
	100.00	100.00	100.00

All made up to 100; although, if my views are right, all must be wrong, for I hold that the strongest base should go to the strongest acid, and that the sulphuric acid and chlorine should be combined with potassium. For, if we mix solutions of carbonate of potash and chloride of potassium, by boiling down we get chloride of potassium and carbonate of soda.

The following *bona fide* copies of analyses of carbonate are still more extraordinary:—

	D.	E.	F.
Carbonate of potash ..	75.65	91.60	Potash 58.61
Carbonate of soda ..	12.41	5.70	Potassium chloride 8.08
Sulphate of potash ..	8.14	—	Potassium sulphate 3.76
Chloride of sodium ..	2.47	2.80	Sodium chloride .. 3.84
Insoluble	1.28	1.40	Insoluble 0.48
Water	0.60	—	Carbonic acid and water } 25.23
	100.55	100.50	100.00

In addition to the other errors, E is wrong in the addition, and F, although made up to 100, is an impossible analysis, for the potash requires 27.37 per cent of carbonic acid alone.

Physical conditions will enormously affect results; it is certain, however, that we have no authority for the statements given above. But there is still the fact that, if one chemist puts it in this way, and another in my way, it is much better to buy carbonate of potash by my analysis, and sell it by the analyses of Messrs. A., B., and C.

* Patterson, "On the Part which Ferric and Aluminic Oxides Play of the Manufacture of Superphosphate, and on the Comparative Value of Mineral Phosphates."—*Proc. Phil. Soc. of Glasgow*, vol. viii., p. 194.

† See CHEMICAL NEWS, vol. xxiii., p. 12.

Again, the soda is sometimes reported as hydrate in carbonate of potash, as in the following example:—

	A.
Carbonate of potash	91.30
Sulphate	2.10
Muriate	1.75
Hydrate of soda	2.55
Silica	0.90
Water	1.10
Insoluble	0.30
	100.00

I am far from averring that hydrate of soda may not exist in occasional instances, though we have never found it; and its presence is unlikely. The statement makes the carbonate appear to contain the smallest possible amount of soda salts, and hence increases its value.

I append also some published analyses of mixed nitrates of potash and soda:—

	A.	B.	C.	D.
Nitrate of potash..	28.90	30.90	10.3	7.3
Nitrate of soda ..	66.70	62.40	84.5	86.3
Muriate of soda ..	2.00	4.30	1.6	1.2
Sulphate of lime..	0.50	0.50	0.4	0.6
Insoluble	0.10	0.10	0.2	0.6
Moisture	1.80	1.80	0.3	4.1
	100.00	100.00	100.0	100.0

Now, in these cases again, all made up to 100, the muriatic acid and (where there is no lime) the sulphuric acid should be combined with the potash, and not with the soda. This has been shown by Henderson, who has proved that nitrate of soda decomposes sulphate of potash.*

In reporting the strength of caustic soda, some analysts still give the "available soda," including carbonate with hydrate. This cannot be right; at least, it is very unfair to manufacturers who show only the hydrate, and have to compete with others who include all the soda; and yet I have heard recently of a buyer even, who will still have his samples reported to include the whole "available soda."

Remedy.—Is there no remedy for these grievances, and cannot the taunt of "high and low chemists" be done away with, or properly met? Mr. Tatlock, in a letter to me, puts the reason of these discrepancies so well that I quote his words:—"They arise from the adoption of so many different processes, and from want of attention to the reliable work that has been done in investigating the methods; the general tendency among chemists being to read papers written by investigators, pass a verdict upon them, and proceed in their usual way, taking no pains to test the improved methods for themselves, much less to adopt them." In fact, it is nobody's business, but yet it is a crying evil and a disgrace. I do not expect to put a stop to occasional variations, but I want the processes and statements standardised by competent authority. On the Continent, one of the scientific societies would appoint a committee to inquire into these processes, and decide and report on the best. Our Chemical Society would probably not hear of this, but I see no reason why the Chemical Section of the British Association should not take it up. They have already appointed a Committee to inquire into the discrepancies amongst gold assayers, differences which are infinitesimal compared to those we complain of; and that committee has already done very good work and added much to our knowledge. I could adduce a number of other commercial analyses the methods of which require looking into, but I propose, in the first instance, to ask them to appoint a committee provided with a suitable grant of money to undertake the investigation of the processes employed in the commercial analysis of superphosphates and salts of potash, and the statement of results.

* Henderson, "On the Decomposition of Sulphate of Potash by Nitrate of Soda."—*Proc. Phil. Soc. of Glasgow*, vol. viii., p. 457.

ON THE ANALYSIS OF NICKEL AND COBALT ORES AND FURNACE-PRODUCTS,

AND ON A

CONVENIENT AND ACCURATE METHOD OF SEPARATING ZINC FROM NICKEL AND COBALT.*

By R. FRESENIUS.

THE ore or furnace-product in fine powder is treated with hydrochloric acid, with the addition of nitric acid, until everything soluble has been dissolved. It is then repeatedly evaporated with hydrochloric acid almost to dryness, in order to expel the rest of the nitric acid. The residue is taken up with hydrochloric acid and water, and filtered. If a residue is left not perfectly white, it is fused with bisulphate of potash, the melted mass treated with hydrochloric acid and water, and the solution filtered, and added to the former. A current of sulphuretted hydrogen is passed through the liquid, which contains a sufficiency of hydrochloric acid, so as to throw down all precipitable metals, the gas being passed in first at the temperature of 70° C., and afterwards in the cold. The filtrate is heated first alone, and then with the gradual addition of nitric acid, to convert the protoxide of iron completely into peroxide. Ammonia is now added in excess; the impure hydrated oxide of iron filtered off, washed a little, dissolved in hydrochloric acid; the solution considerably diluted, mixed with sal-ammoniac, and then, in the cold, with a dilute solution of carbonate of ammonia until the liquid takes a somewhat turbid appearance, without, however, the formation of a precipitate. On standing, it should not become bright, but, of the two, rather more turbid. The reaction of the liquid is still decidedly acid. It is heated now to a boil, the precipitate of basic per-salt of iron is washed with boiling water, first by decantation, and then upon the filter, and a portion of the basic salt is then tested by dissolving in hydrochloric acid, repeating the basic precipitation, and testing the filtrate with sulphide of ammonium for traces of nickel. If, in this operation, nickel is found, the entire precipitate is dissolved in hydrochloric acid, and the oxide of iron once more separated out as a basic salt in the same manner. The two or three filtrates, as the case may be, containing the nickel and cobalt are now mixed together, acidulated with acetic acid, and concentrated by evaporation. If a slight precipitate is separated (oxide of iron or alumina), it is filtered off, re-dissolved in hydrochloric acid, the solution precipitated with ammonia in excess, and the operation again repeated. The filtered and sufficiently-concentrated solution, containing all the nickel and cobalt, is now mixed with carbonate of soda till the reaction becomes distinctly alkaline; acetic acid is added till it predominates. To the clear liquid, 30 to 50 c.c. of a solution of acetate of soda, containing one-tenth its weight of the dry salt, and sulphuretted hydrogen, is conducted into the liquid at a temperature of 70° C. When the precipitation is complete, the sediment of the sulphides of nickel and cobalt is filtered off, washed, and dried. The filtrate is concentrated, sulphide of ammonium, containing an excess of sulphuretted hydrogen, is added, and afterwards acetic acid, and thus a second precipitation of sulphides of nickel and cobalt is often obtained. For safety's sake, the filtrate is tested once more, to be quite certain that all nickel and cobalt has been precipitated in the state of sulphide. The dried sulphides of nickel and cobalt, together with the ash of the filter, is now treated with hydrochloric acid, with the addition of nitric acid, until completely decomposed and dissolved. The solution is evaporated with hydrochloric acid, in order to expel the nitric acid, diluted with water, filtered, and the solution precipitated with pure potassa-lye, preferably in a large platinum capsule. The precipitate obtained is thoroughly washed with boiling

* *Zeitschrift für Analytische Chemie*.

water, first by decantation, and then on the filter. It is then heated in the air till the filter is completely incinerated, and ignited in a Rose's crucible in a stream of pure hydrogen till the weight is constant. The metallic cobalt and nickel are treated in the crucible with boiling water. If the liquid shows an alkaline reaction, or the presence of chlorine or sulphuric acid, or leaves a residue when evaporated on platinum-foil, the metals are exhausted with boiling water, again ignited in a stream of hydrogen, and weighed again. The metals are now dissolved in nitric acid, whereby generally a small quantity of silicic acid remains undissolved. It is collected upon a small filter, and its weight determined. The nitric acid solution is almost neutralised with ammonia, carbonate of ammonia is then added in excess, and the whole gently heated for some time. The slight precipitate of hydrated oxide of iron and alumina which is usually formed is filtered off, dissolved in hydrochloric acid, and re-precipitated with carbonate of ammonia. The small precipitate is ignited, first in the air, and then in a stream of hydrogen, and its weight, together with that of the silicic acid, is deducted from the gross weight of the metals.

If the ores or furnace-products contain zinc, the mixture of nickel and cobalt obtained as above contains zinc. In this case, the hydrochloric solution, obtained by dissolving the sulphides of nickel and cobalt, after it has been reduced to a small volume, is mixed with pure chloride of ammonium in small crystals, to such an extent that 5 parts of chloride of ammonium are allotted to 0.2 of oxide of zinc. The moist saline mass is evaporated to dryness on the water-bath, and carefully heated till all the sal-ammoniac, and with it all the zinc, has been volatilised. The residue of metallic nickel and cobalt is dissolved in hydrochloric acid, with the addition of nitric acid; the greater part of the free excessive acid is driven off, the residue precipitated with potassa, and treated further as above.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

A MEETING was held in the Physical Laboratory, South Kensington Museum, on Saturday, April 18, Dr. Gladstone, F.R.S., the President, in the Chair.

Dr. W. H. STONE read a paper "*On Wind-Pressures in the Human Chest during Performance on Wind-Instruments.*"

Mr. A. TRIBE showed experiments illustrating the action of hydrogen upon finely-divided metals, such as are produced by precipitation.

At the next meeting, to be held at 3 p.m. on Saturday, May 9, the following papers will be read:—Dr. Rae, "On certain Physical Properties of Ice." Dr. Guthrie, "On an Absolute Galvanometer." Dr. Stone, "On the Fall in Pitch Occurring in Strained Wires through which a Galvanic Current is Passing."

NOTICES OF BOOKS.

The Birth of Chemistry. (Nature Series.) By G. F. RODWELL, F.R.A.S., F.C.S., Science Master in Marlborough College, London. Macmillan and Co.

THE history of chemistry, or, indeed, of any branch of science, is not a favourite subject in England even with the initiated, not to speak of the half-educated "intelligent and respectable." With the exception of Dr. Thompson's work, now somewhat out of date, and of the very meagre account of the rise and progress of chemistry in Whewell's "History of the Inductive Sciences," our literature in this

department is almost a blank. Mr. Rodwell has, therefore, selected no hackneyed subject. His object, as stated in the preface, is "mainly that we may mark the attitude of thought which actuated the scientific mind in bygone times, and may thus be led to compare the ancient with the modern method of evolving ideas, and building them up into a connected whole."

The author successively passes in review the primitive theories affecting the history of matter, the metallurgy of the ancients, alchemy, early ideas respecting the nature of combustion and the rise of pneumatic chemistry. As regards the antiquity of the science, he takes a medium view, neither seeking its origin as far back as the days of Moses, nor, with certain French authorities, pronouncing it to have arisen suddenly in France in the eighteenth century. The work bears the impress of careful and critical study, and of decided originality of view.

A variety of illustrations, representing ancient and mediæval apparatus, symbols—complex enough to find favour in the present day—and allegorical representations of reactions and processes, with facsimiles of portions of alchemical manuscripts, enhance the interest of these pages. We can cordially recommend Mr. Rodwell's little work to all students of chemistry, and we hope that he may on some future occasion return to the subject and continue his history down to the present day.

Report on Public Health. By C. A. CAMERON, Ph.D., M.D., &c. London: Falconer.

A SERIES of essays having no other connection than their common bearing upon public health. The author treats first on "Nitrogen Compounds in relation to Water Contamination." He thinks it necessary to determine, in addition to the ammoniacal salts and albumenoid ammonia in waters, the gypsum and the chlorine. He considers that in "limestone districts water which had never been contaminated with sewage often contains very large amounts of nitric acid." This circumstance, to which Dr. Cameron calls the especial attention of sanitary chemists, makes strange havoc of the doctrine of "previous sewage contamination."

Next follows a paper on the "Mortality of Flax-Mill and Factory Workers," with reference to the effects of dust on the respiratory organs. In the next essay Dr. Cameron takes up the vexed question of "Typhoid Spread of Milk." We have already expressed the opinion that zymotic disease may be thus propagated; at the same time, we cannot help pointing out that the number of cases of enteric fever in the western districts of London has been this year below the average. The paper on the "Management of Children" has no direct chemical interest. More important are the remarks on the "Hygiene of Dwellings," couched in the form of a critique on Pettenkofer's work on "The Relations of the Air to the House We Live In and the Clothes We Wear." The significant fact is pointed out that in loose soils especially there is a large amount of air richer in impurities than in the air above ground. This underground air may be drawn into the interior of houses, owing to the temperature within being higher than that without, and producing an ascending current like that in a chimney. Our houses ventilate themselves, not only through the walls, but also through the ground on which they stand. Says Pettenkofer: "We took rather a short-sighted view all the while when we believed that the nuisances of our neighbours could only poison the water in our pumps: they can also poison the ground—air for us—and I see more danger in this, as air is more universally present and more mobile than water."

We must here call attention to a novel danger. If the surface of the ground in the streets is rendered practically air-tight by a layer of asphalt, all subterranean gases and vapours will find vent in our houses, where no such resistance is encountered, and which must serve as up-cast shafts for the whole district. It would, therefore, be a wise precaution to underlay every house with a layer of

asphalte thicker than that in the streets, so that the resistance indoors may be greater than that without. We are glad that Dr. Cameron has officially called public attention to the contamination of the air from below.

Spectrum Analysis as Applied to Microscopic Observation.

By W. T. SUFFOLK, F.R.M.S. London: J. Browning.

THE use of the spectroscope as an auxiliary in microscopic research is, as yet, in its infancy. The published matter relating to the micro-spectroscope is, as the author states in his preface, scattered through the pages of various scientific periodicals. A book like the present is therefore needed for the guidance of beginners. The main portion of the work is the substance of a lecture delivered before the South London Microscopical Club. To this has been added an appendix on the structure and use of the micro-spectroscope, a list of papers in various scientific journals on absorption-spectra and the micro-spectroscope, and a number of plates with explanations.

We hope that this little work may prove the means of inducing an increased number of observers to turn their attention to a subject as yet all but unexplored.

Second Annual Report of the Imperial Mint, Osaka, Japan.

For the year ending July 31st, 1873. Printed by order of the Council of State. Hiogo: "Hiogo News" Office. 1873.

THIS pamphlet gives an interesting proof of the progress of physical science in Japan. That there is in that far distant realm a Mint, fitted up with all the chemical and mechanical appliances known in Exrope, will possibly be news to some of our readers. We find that sulphuric and nitric acids of good quality are now manufactured in Japan, and that the refinery is "capable of undertaking for the public the parting of gold and silver, and also the purification of these metals, at very moderate charges." Mr. Miller's apparatus for treating "brittle" gold with chlorine has been erected, but the quality of the bullion sent in has been such as not to require its use.

A memorandum of Mr. Gowland, chemist and metallurgist to the Mint, contains some interesting particulars on refractory clays, and on Japanese coal and copper. Some of the kaolins compare favourably with the best Stourbridge fire-clay; others are fusible from the presence of iron or of alkalies. The ash in five samples of coal previously dried at 100° C. was high, ranging from 6.487 to 12.760; the percentage of sulphur varied from 0.383 to 0.654 per cent, which, as Mr. Gowland remarks, is less than that present in average British coals. The samples of Japanese copper examined were remarkably free from antimony, and generally from arsenic. One sample, however, contained 0.159 per cent of arsenic, and another 1.384 of lead. Certain crude Japanese coppers contain so much iron that a modification of the ordinary mode of refining should be adopted.

It is satisfactory to learn that all the chemical posts in connection with the Imperial Japanese Mint are filled by Englishmen.

Instructions in Photography. By Captain ABNEY, R.E., F.C.S., F.R.A.S. London: Piper and Carter.

THE elementary literature of photography has been tolerably copious in this country. There has been no lack of instruction books; but they have been, for the most part, characterised by two faults—they have been empirical and shoppy. Some of them have contained intelligent instructions for practice, but have been silent or erroneous as to the scientific bases of the art; whilst others have been manifestly prepared to aid the business purposes of the dealer in photographic material. The manual before us is free from both the drawbacks we have indicated. Captain Abney's instructions were, we understand, originally prepared to aid the studies of the

Engineers at Chatham, where the photographic tuition is under his charge. Besides being simple and lucid in style, and comprehensive in its range, the work possesses two good qualities, which are worthy of note. In the first place, all the instructions possess the manifest authority which familiar practical knowledge gives to a writer; and, in the next place, an attempt is made throughout to explain the *rationdle* of the various reactions resulting from the operations under hand. To avoid embarrassing the beginner with explanations, which he could scarcely understand until he was familiar with the operations to which they refer, these explanations are given as notes accompanying the text, which may, however, be read without the notes or with, as the proficiency of the student may dictate. All the usual branches of photography are exhaustively treated, and especially full information is given on the subject of photo-mechanical printing, in which Captain Abney is an expert. Altogether, the manual is one we can commend to all interested in the study of photography.

CORRESPONDENCE.

ANTHRACEN.

To the Editor of the Chemical News.

SIR,—In answer to Mr. T. H. Davis's article on anthracen in CHEMICAL NEWS, vol. xxix., p. 169, I beg to draw his attention to my lecture on anthracen and alizarin, delivered at the Society of Arts on March 20. I think Mr. Davis will find that in my paper, and in the subsequent discussion, all the points were thoroughly ventilated to which he draws attention.—I am, &c.,

FRED. VERSMANN.

18, Billiter Street, London,
April 23, 1874.

ADULTERATION OF FOOD.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS, vol. xxix., p. 162, you honoured me with a critique of my little book on "Adulterations of Food," and in the course of your remarks stated that you regret I still attach a certain value to the indications of the lactometer. From the sentence immediately following, I gather that in your opinion a lactometer is an instrument constructed on the principle of the hydrometer, and you give an excellent reason why the indications of such an instrument are likely to be fallacious. I beg, however, to inform you that the instrument I speak of and describe in "Adulterations of Food" is not at all adapted for the purpose of taking the specific gravity of milk, but is simply to be used in the measurement by volume of the proportion of cream present in that fluid.

With regard to the statement made by Dr. Muter in the *Food Journal* (vol. ii., No. 13), respecting the adulteration of wine with elderberries, I opine that the terms "jerupigia" and "elderberry brandy" are synonymous.

I am grieved that Mr. Estcourt fails to see a resemblance between my drawings and his tea-leaves; the former were nevertheless copied from Nature.—I am, &c.,

ROWLAND J. ATCHERLEY.

London, April 27, 1874.

INDIRECT ESTIMATION OF POTASH AND SODA

To the Editor of the Chemical News.

SIR,—The publication by Mr. F. Maxwell Lyte of a note on this subject brought to my recollection some calculations I made more than twenty years ago in the same direction. On turning up a note-book of the period, I find

the following:—"To calculate the respective quantities of sulphate of potash and sulphate of soda in a mixture of those salts, multiply SO_3 by 9.65156, and subtract result from weight of mixed sulphates $\times 5.4375$; the result is sulphate of potash, and the remainder of the mixture sulphate of soda." I also find the following:—"To calculate the respective quantities of KCl and NaCl in a mixture, salts $\times 4.6564 - \text{Cl } 7.673 = \text{KCl}$." I distinctly remember applying the latter formula to the analysis of commercial potash salts (such as "muriate of potash") in this way—The SO_3 was calculated to K_2SO_4 , and this, with the H_2O , insoluble, and Na_2CO_3 , deducted from 100; the remainder was KCl and NaCl, from which the respective salts were calculated by the above method. I have applied the same system to the estimation of Fe_2O_3 and FeO in a mixture, and, in fact, the principle is applicable to all cases where these elements are present, one of which can be estimated with accuracy.

As regards the estimation of potash, I would not like to hazard my reputation as an analyst upon results obtained by the indirect method. The platinum process, as improved by Mr. Tatlock, gives results of such accuracy as to satisfy all the requirements, not only of trade, but of scientific investigation.—I am, &c.,

WILLIAM WALLACE.

42, Bath Street, Glasgow,
April 22, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, March 9, 1874.

Note on the Theory of Swell.—M. Resal.—This theory, as lately propounded, is only applicable, the author thinks, to comparatively small sheets of water, as lakes, and the rotation of the earth is neglected, which in certain oscillations plays an important part.

Note on a New Spiral Regulator for Chronometers and Watches.—M. Phillips.—The author sought to make the flat spirals more conformable to theory, by furnishing besides the exterior theoretical terminal curve a second and interior one, corresponding to the other end of the spiral. The chronometers thus fitted are shown to have been greatly improved as regards isochronism.

Researches on Crystalline Dissociation (continued); Estimation and Distribution of Work in Saline Solutions.—MM. Favre and Valson.—The authors here give results of comparison, as regards volume change, between normal saline liquors of acids, and the bases giving rise to them.

Particular Arrangement of Micrometer with Movable Wires, Proposed for Telescopes to be used in Observing the Transit of Venus.—M. Hatt.—One important point in the transit observations is to measure the distance of the planet from the sun's border. The micrometer suitable for this is less so for another important measurement, that of the common chord between the two stars during entrance or exit; appreciation of the instant when this chord attains a determinate size. M. Hatt's arrangement is meant to meet this want.

Additional Note on Waves of Variable Height and Velocity.—M. Bertin.

Dispersion of Gases.—M. Mascart.—The author shows how his method for measuring refraction of gases may here be applied. This method was, briefly, as follows:—The apparatus consisted of a spectroscopic, in which the collimator was considerably apart from the

refracting prisms. The parallel rays from the collimator were, by one of M. Fizeau's biplates, cut into two parallel bundles separate by several millimetres. These bundles traversed two tubes of gas, closed with glass plates, were then brought together again by means of a biplate having a direction opposite to that of the former, and were largely refracted by the prisms. The two bundles being caused, by difference of pressure in the tubes, to progress differently, the order of the fringe F observed at a point of the spectrum with wave-length λ is connected with the difference of progression, Δ , by the equation $\Delta = F\lambda$. Then, on gradually altering the pressure in one of the tubes, the fringes are seen to move towards the red or towards the violet, according as the difference of pressure increases or diminishes. For measuring dispersion the author illuminates the collimator with a Drummond light, and also makes some induction sparks pass before the slit. The spectrum is illuminated throughout, and one can observe the bright lines of metallic vapours and Talbot's bands. One of the two gas tubes being at pressure H , the observer counts the number of fringes between the different bright lines. The pressure is then changed to H_2 , and the fringes between the same lines are counted anew. M. Mascart gives the numerical results in the case of several gases. It appears that the dispersion is not in direct relation with either the refraction or the density of the gas. Certain gases, as protoxide of nitrogen and cyanogen, have a dispersion superior to that of water.

Wave-Lengths and Characters of Violet and Ultra-Violet Solar Rays, obtained Photographically by means of a Grating.—Prof. Draper.—This paper has already appeared in English form.

Probable Character of the First Fortnight of March.—M. De Tastes.

On Hydrogenised Palladium.—MM. L. Troost and P. Hautefeuille.—The authors find that the "occlusion" of hydrogen in palladium is a phenomenon more complex than was previously supposed. They examine the two questions,—Does hydrogen combine with palladium, or is it simply dissolved in that metal? If there is combination what is the formula of the compound produced? Their experiments show that palladium forms with hydrogen a definite compound, Pd_2H . This compound, when once formed, can dissolve hydrogen in amounts varying with its physical condition. This property of the compound, Pd_2H , explains the difference of the results obtained by Graham, according as he used palladium in the state of wire or of sponge.

Apparatus for the Determination of the Tannin Contained in the Astringent Matters used in Tanning.—M. A. Terreil.—We notice this paper elsewhere.

Use of the Sulphate of Copper for Preserving Wood as Compared with the Tannate of Iron.—M. A. Hatzfeld.—This paper is also noticed elsewhere.

Reply to the "Reclamation" of M. Béchamp on the Beer-Yeast Question.—M. P. Schützenberger.—The writer admits the priority of M. Béchamp as regards the discovery of the gummy matter and of tyrosin, but claims for himself the discovery, in yeast, of carnin, xanthin, guanin, and sarcin.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 3, February 23, 1874.

Constitution of Phenyl-Bromethyl and its Derivative Hydrocarbons.—Br. Radziszewski.—This paper is not adapted for abstraction.

Action of Sulphur upon the Benzoate of Baryta.—Br. Radziszewski and A. Sokolowski.—The results of the reaction are very complicated, but neither tolan nor sulphate of baryta is formed. Among the products obtained are benzol, benzoic acid, diphenyl, benzophenon, a mercaptan compound boiling at a high temperature, a residue

of carbon and sulphide of barium, and a gaseous mixture containing sulphuretted hydrogen and carbonic acid.

Presence of Leucin and Asparagin in the Recent Juice of Vetch-Sprouts.—The author found these substances in the sprouts of vetches that had germinated in darkness.

Constitution of Dinitro-Benzol.—C. Wurster.—A lengthy hypothetical paper, not adapted for abstraction.

Crystallographic and Chemical Relations of the Natural Sulphides, Arsenides, and Sulpharsenides.—C. Rammelsberg.—The author, after referring to the well-known heteromorphism of the metallic sulphides, especially the bisulphide of iron, shows that the two forms of the latter recur in certain metallic sulpharsenides, and in such a manner that we are perfectly justified in regarding this resemblance as isomorphism. FeS_2 is isomorphous with FeAsS , CoAsS , and NiAsS . But it does not follow that arsenic and nickel are isomorphous. The isomorphism of compounds does not prove the isomorphism of their respective constituents. The second form of FeS_2 , cock's-comb pyrites, is repeated in arsenical pyrites. There are, in fine, two heteromorphous series of metallic compounds whose members consist either entirely of RS_2 , or of R_mAs_n , or of a mixture of both. They may be named the pyritic and markasitic series. Those arsenical compounds in which R is exclusively iron, rarely iron and cobalt or nickel, are known only in the markasitic series and comprise the bodies known as arsenical iron and arsenical pyrites. The very numerous mixtures in which R stands cobalt, nickel, and iron are found in both series.

The Fermentation Question.—J. Moritz.—The author contests the view of Brefeld that the vital, but not growing, yeast cell, in the absence of free oxygen, excites alcoholic fermentation in solutions of sugar, from which it would follow that in the fermentation of wine air should be excluded instead of admitted as practice indicates. He deduces from his experiments that the growth of yeast is directly proportional to fermentation.

Certain Compounds of Aldehyd.—M. Nencki.—An examination of ethyilden-benzamid, ethyilden-urethan, and diethyilden-sulphurea.

On Substituted Phenol-Sulphacids.—Jul. Post and Fr. Brackebusch.—Not adapted for abstraction.

On Bromo- and Iodo-Nitro-Sulpho-Phenol Obtained from Ortho-Nitro-Phenol—Jul. Post and Fr. Brackebusch.—The authors have prepared iodo-nitro-sulpho-phenol and bromo-nitro-sulpho-phenol, and have examined certain of their salts.

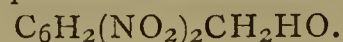
A Lecture Experiment with Potassium.—H. Kæmmerer.—The author shows the green vapour of potassium by evaporating the metal in a current of hydrogen gas in a wide horizontal tube.

On Derivatives of Diphenyl.—A. Osten.—The compounds examined and described are—Mono-nitro-diphenyl; monamido-diphenyl; hydrochlorate of monamido-diphenyl; sulphate, oxalate, and nitrate of the same base; hydrochlorate of monamido-diphenyl-platin chloride; mono-hydroxyl-diphenyl; and acetamido-diphenyl.

Explanation of the Difference in the Boiling-Points or Metameric Bodies.—Alex. Naumann.—A hypothetical paper, not suitable for abstraction.

On Cresol-Colouring Matters.—H. Wichelhaus.—The salt of binitro-cresol which gives occasion for this notice was obtained from the Vienna Exhibition last year, where the artificial yellow colouring matters shown were picric acid, chrysanilin, and binitro-naphthol. Dusart exhibited mono-nitro-naphthol, which is no commercial product, but a laboratory preparation. In the Belgian Section was seen a "gold-yellow," which at first sight resembled the salt of mono-nitro-naphthol, but showed a decided difference upon closer examination; it consisted of brown granular masses, which deflagrate briskly when

heated, and dissolve in water with an intense yellow colour. It is the potash salt of binitro-cresol—



Third Nitro-Phenol Corresponding to Dinitro-Benzol.—R. Fittig.—Not adapted for abstraction.

Molecular Compound of Acetic Acid with Bromine and Hydrobromic Acid.—A. Steiner.—This compound consists of—

Bromine	44.3
Hydrobromic acid.. ..	22.5
Acetic acid	33.2
	<hr/>
	100.0

New Synthesis of Succinic Acid.—A. Steiner.—Succinic acid was obtained by heating together equal equivalents of chloro-carbonic ether, bromacetic acid, and powdered silver, at 130° in a sealed tube.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 3, March, 1874.

Report on Constantin's Procedure for Glazing Cheap Earthenware.—M. Salvétat.—The author calls attention to the imperfections and dangers of the common lead-glazes, and proposes the following mixture:—

Silicate of soda at 50°	100 parts
Red-lead.. .. .	25 "
Finely-ground flints	10 "

The glaze thus produced is not attacked by vinegar or by fatty matters.

Assimilation of Nitrogen by Plants.—In a notice of Deherain's work on agricultural chemistry, recently published, the important question is raised—In what form is nitrogen assimilated by plants. Kuhlmann maintains that nitrates are not taken up until reduction has taken place, and their nitrogen has entered into an ammoniacal combination. On the other hand, Cloëz holds that ammoniacal salts are inactive till their nitrogen has passed into a nitro-compound. Neither of these views has as yet been demonstrated. M. Deherain combats the view of M. Ville that plants can assimilate directly the free nitrogen of the atmosphere, but he holds that in soils containing decomposing organic matter the nitrogen of the air forms ammonia in the absence of oxygen. Carbonic acid is formed, and the nascent hydrogen unites with the atmospheric nitrogen to form ammonia.

Nitrification of Vegetable Soil.—M. Boussingault.—The author has formerly attempted to point out the analogy between a nitre-bed and a manured arable soil. He has now undertaken a series of experiments to determine what share the nitrogen of the atmosphere has in the process of nitrification. The result was that in the nitrification of a vegetable mould, accomplished in a confined and unrenewed portion of stagnant air, the nitrogen of the atmosphere takes no part. The nitrification in such cases takes place at the expense of nitrogenous organic matter.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 8, February 19, 1874.

This number contains no chemical matter.

No. 9, February 26, 1874.

Use of Glycerin to Prevent the Formation of Incrustations in Steam-Boilers.—M. Asselin, of Paris.—Glycerin, added in the proportion of 1 kilo. for every 5000 to 8000 kilos. of fuel consumed, is recommended on account of its power of increasing the solubility of sulphate of lime, and causing the undissolved portion to be precipitated in a granular form, so as not to adhere to the metal.

Action of Sulphuric Acid upon Decidene (Essence of Turpentine).—E. J. Mauniené.—The author, in opposition to Deville and Ribau, maintains that the sole product of the reaction is decifene (cymene).

No. 10, March 5, 1873.

This number contains no original chemical matter.

No. 11, March 12, 1874.

The Absorption-Spectra of Blood.—M. Fumouze.—This is a notice of a work on the above subject, too lengthy to be transferred to our pages.

Revue Universelle des Mines, de la Metallurgie, des Travaux Publics, des Sciences et des Arts Appliqués à l'Industrie, November and December, 1873, January and February, 1874.

These numbers contain no chemical matter, except a paper on the manufacture of white-lead, which has already appeared in the CHEMICAL NEWS.

MISCELLANEOUS.

Adulteration of Food.—During the year 1873 Dr. Cameron made 386 analyses of food and drink, of which 108 were adulterated, 16 pure but of bad quality, and 262 pure. Of the adulterated specimens, the milk was adulterated with from 12 to 120 per cent of water, but with no other adulterant. The bread was adulterated with alum, and in some instances it contained a large quantity of sandy matter. The flour was adulterated with alum, and six of the samples contained grit or sandy matter. The tea was composed of exhausted and decayed leaves, strengthened by the addition of some stringent gums. The coffee was adulterated with chicory and burnt sugar. The rum was wholly spurious, being new whiskey sweetened with treacle, and being 25 per cent under proof. The butter examined contained no foreign matter, but four samples were rancid and unfit for use. The oatmeal was very mouldy, full of fungoid growths, and unfit for use. Twenty-three well waters used in Dublin were examined, and of these 16 proved to be loaded with dangerous organic impurities, and were utterly unfit for use. Fourteen specimens of green wall paper on sale in the city were examined, and fourteen of them found to be coloured with arsenical green. The following quantities of food were condemned as being unsound:—

Beef	147,815 lbs.
Veal	2,100
Mutton	6,640
Pork	19,356
Bacon	7,139
Fish	34,220
Butter	72
Fruit and vegetables ..	450
Bread	6,000
Flour	560
Tea	200

Total 224,552

The fines and costs imposed on 43 persons convicted for selling adulterated food amounted to £252 11s. Of the 21 persons convicted for selling or being possessed of diseased or unsound meat, 11 were fined £49 17s. The others, 10, were imprisoned—3 for 3 months each, 3 for 2 months each, 2 for 6 weeks, and 2 for 14 days each. Total convictions, 64. During the last four years 1438 sanitary analyses have been performed, 1,432,521 lbs. of unsound food condemned, 139 persons fined for selling adulterated food, 72 persons fined for selling or having in their possession diseased meat, and for the latter offence 21 persons were imprisoned for periods varying from 14 days to 3 months. The fines imposed amount to nearly £1,000. The names, offences, &c., of several adulterators were advertised at their own expense.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of metallic alloys, and in apparatus to be used for this purpose. Alexander Parkes, Gravelly Hill, near Birmingham. June 19, 1873.—No. 2151. This Provisional Specification describes an apparatus and process for making principally alloys of copper and manganese.

An improved process for preserving wood. Charles Brown, M.D., 8, Southampton Buildings, London. June 20, 1873.—No. 2156. The nature of my invention consists in filling the pores of the wood with lime, or a mixture of lime and sand.

Improvements in the manufacture of soda and chlorine. Alexander Robertson Arrott, chemist, Saint Helen's, Lancaster. June 27, 1873.—No. 2236. This Provisional Specification describes the manufacture of soda and chlorine from common salt. For this purpose, phosphate of peroxide of iron and common salt are exposed at a red heat in a suitable furnace to the action of air or steam, or both, by which means the common salt is decomposed.

An improved liquid for destroying vegetable life and checking its development. Spencer Dunn, manufacturing chemist, Princes Square, Finsbury, Middlesex. July 1, 1873.—No. 2278. The liquid contains arsenic in sufficient quantity to kill weeds or destroy vegetable life and check its development.

Improvements in the treatment of finely-divided iron ores, iron-sands, or mine-dust, with a view to smelting the same in blast-furnaces. Martin Rae, Uphall, Linlithgow, N.B. July 2, 1873.—No. 2297. The difficulty hitherto preventing the smelting of finely-divided iron ores, iron-sands, and mine-dust, are as follows:—If these ores are used alone, they stop up the draught of the furnaces altogether, or are blown out at the throat if the blast is increased to overcome the obstruction. To obviate this difficulty, various plans have been tried, by mixing the ores with clay, mud, and other plastic materials, but hitherto without success, on account of the agents employed being of a non-combustible character, the furnaces requiring a larger percentage of fuel, and producing a greater amount of slag than usual. Now, my invention consists in the preparation of a mastic from the residues of the distillation of mineral oils, as is well understood, which mastic I use as a cement for binding the iron ore or mine-dust together, and by pressure I convert the same into solid blocks, which blocks can then be smelted in a blast-furnace. In districts where the aforesaid ores are located near to blast-furnaces, it may be found economical to mix the ore or mine-dust with a due proportion of coal-dust, coke-breeze, or powdered charcoal, to act as fuel; also a due percentage of powdered lime, to act as a flux; this composition to be mixed with the aforesaid mastic, and pressed into blocks as above set forth.

Improved processes for plating iron, steel, and other metals with nickel. William Robert Lake, of the firm of Haseltine, Lake, and Co., patent agents, Southampton Buildings, London. (A communication from Henry Tudor Brownell, Hartford, Connecticut, U.S.A.). July 2, 1873.—No. 2302. I apply nickel to the iron, steel, copper, brass, or other metal, either by electro-plating or any other of the ordinary methods of covering metals with a thin film of nickel, and then subject the metal so plated to a temperature of from 480° to 700° F., or the metal is first heated in water at or near the boiling-point, and is then immersed in the plating-fluid heated to the same temperature.

Improvements in the treatment of sewage-water, and in the manufacture of manure. Jeremiah Marsden, iron founder, and John Collins, analytical chemist, Bolton. July 4, 1873.—No. 2317. Our invention consists in subjecting sewage-water to the action of certain agents, by which the solid and fertilising portion is precipitated to be converted into manure, and the water is cleared and allowed to run off. The agents we employ are lime, coal ashes, or other refuse of coal, and charcoal or carbon, combined with a salt of soda, potash, iron, manganese, or the like.

NOTES AND QUERIES.

Determination of Anthracen.—(Reply to "Student.")—Consult the CHEMICAL NEWS of April 17, and some of the older numbers. The following works also give a quantity of valuable information on this subject:—"Traité des Dérivés de la Houille," and "Das Anthracen und sein Derivative."—T. H. DAVIS.

MEETINGS FOR THE WEEK.

MONDAY, 4.—Medical, 8.

— Society of Arts, 8. Cantor Lectures.

— London Institution, 4.

TUESDAY, 5.—Civil Engineers, 8.

— Anthropological, 8.

— Zoological, 8.30.

WEDNESDAY, 6.—Society of Arts, 8. F. E. Thicke, "On Timber Houses."

— Microscopical, 8.

THURSDAY, 7.—Royal, 8.30.

— Royal Society Club, 6.

— Chemical, 8. Dr. Tommasi, "On the Constitution of Urea." Dr. Gladstone and A. Tribe, "Researches on the Action of the Copper-Zinc Couple on Organic Bodies; Part VII., On the Chlorides of Ethylene and Ethylidene." Mr. A. Liversidge, "On a Mineral from New Caledonia."

FRIDAY, 8.—Society of Arts, 8. Dr. Griffin, "On Sugar Refining."

— Quekett Microscopical Club, 8.

THE CHEMICAL NEWS.

VOL. XXIX. No. 754.

ON THE INDIRECT DETERMINATION OF ALUMINIUM OXIDE IN THE PRESENCE OF FERRIC OXIDE.

By R. W. EMERSON MACIVOR.

THE aluminium and ferric hydrates are thrown down from solution in the ordinary manner, by the addition of ammonium hydrate, and the precipitate is collected on a filter, dried, ignited, and weighed. The ignited precipitate is then rubbed to a fine powder in an agate mortar, and carefully washed into a long necked flask. Metallic zinc (quite free from iron) is next added to the contents of the flask, and finally some sulphuric acid. The whole is then heated over an argand burner until the oxides have dissolved. The quantity of iron in the fluid is then estimated volumetrically by the potassium permanganate process. From the iron found, the quantity of ferric oxide contained in the precipitate is calculated, and this amount subtracted from the total weight of the mixed oxides gives, of course, the quantity of aluminium oxide contained in the mixture.

This process is rapid of execution, and gives good results.

67, Park Road, Glasgow,
May 2, 1874.

ANALYSIS OF ASHANTEE GOLD.

By Prof. A. H. CHURCH.

As a special interest is attached to the subject of the native gold of Ashantee just at present, I have submitted to analysis a fair sample of the metal, cutting off portions of several small nuggets for that purpose. The colour of the nuggets is very uniform and rich, and would indicate, perhaps, the presence of a smaller quantity of alloy than that which actually occurs in them. The surface-colour of this native gold is further deepened by the red hæmatitic earth which adheres to it. Now and then, however, a nugget of paler tint may be observed, but the difference of tint is not due in the cases I have examined to the presence of more alloy, but rather to the less compact character of these specimens, and to the fact that they contain, in lieu of a red ferruginous mineral, traces of a dark siliceous earth.

A most careful analysis of an average sample of Ashantee native gold gave me the following numbers:—

	In 100 parts.
Gold	90.055
Silver	9.940
Copper	very minute trace
Iron	trace
Specific gravity at 16° = 17.55.	

ANALYSIS OF ANIMAL CHARCOAL (BONE-BLACK).

By G. COMBE STEWART, F.C.S., Greenock.

THE importance of the study of chemistry is now generally acknowledged; besides the various observations in Nature which excite curiosity the experimental method furnishes one of the most salutary exercises for the mind, constituting in this respect a fitting supplement to the study of the mathematical sciences.

The method of deduction in these, while eminently adapted to form the habit of strict reasoning, scarcely affords any exercise for the critical faculty, which plays so important a part in chemical science.

In the many branches in which chemistry is applied to this art that section which treats of the analysis and manipulation of animal charcoal is the most important. The chemical analysis of animal charcoal forms the foundation plate of success in working it in that great laboratory, the sugar refinery. In it all the work done should be conducted on chemical principle, and no sugar-refiner who works contrary should expect too much from any sample of charcoal, because there is no substance in which he is more apt to be deceived than the treatment of this material on any other principle than that of modern scientific basis.

Charcoal to the eye may exhibit satisfactory properties and yet be totally useless for sugar refining; yet, notwithstanding this fact, some merchants expect the same work from it as from a genuine sample. If the charcoal does not possess chemical properties, which are characteristic of the finest bone-black, how can a sugar-refiner hope to take it out of it in the face of chemical facts? No; facts are facts—natural philosophy follows.

Knowing, then, that the proximate analysis of animal charcoal is of the highest importance, the following general process and remarks will be found very suitable in effecting such.

In determining the moisture, carbon, and total organic matter, a weighed portion of the charcoal may either be submitted to direct combustion in a suitable furnace, collecting the products in the usual manner, or the moisture may be determined by drying a weighed quantity in the hot-air chamber at a temperature of 160° to 180° C. for six hours. The loss in weight is moisture, and on ignition of the residue it will supply the sum of the carbon and organic matter. In careful hands both processes are excellent, and should correspond with each other, remembering the fact that charcoal when ignited the loss in weight is equal to the sum of the moisture + carbon, + total organic matter.

Should it be desired to determine the carbon by the *solution* method, viz., treatment with hydric chloride, the carbon is obtained insoluble, mixed up with the siliceous matter, which can be separated by direct ignition. Particular attention must, however, be bestowed to this carbonaceous residue in determining the carbon by this method. I have found considerable difficulty in washing it free from hydric chloride, and in drying it so as to obtain the siliceous matter with accuracy on ignition.

By attaching to the filtering apparatus a suction-pump (such as is described on page 61 of Dr. Thorpe's "Quantitative Chemical Analysis") the residue may be obtained in a very superior manner and leaves nothing to be desired. It should be dried at 160° to 180° C. in the hot air chamber, and then weighed. The practice of drying this residue at 100° C. instead of 160° to 180° C. is in my opinion a mistake. I hold the same views with respect to determining the moisture at water-bath heat.

Were the latter assertion true, we should obtain on direct ignition, after the treatment in the water-bath, a result something like 4 to 5 per cent of organic matter in every sample of charcoal which we had occasion to analyse; but no charcoal contains this amount of organic matter (exceptional instances overlooked).

The oxide of iron, which is very constant in amount in new and old char, is best determined volumetrically by dilute standard solution of the potassic anhydro-chromate (Penny's process), or better by dilute standard solution of the potassic permanganate, using 0.5 gm. KMnO_4 in 1 litre distilled water; and the phosphoric acid may be determined with advantage by using a standard solution of uranium nitrate or acetate. Should chlorine be detected in any appreciable amount it is best determined volumetrically by standard solution of argentic nitrate and neutral chromate of potassium.

With regard to the moisture in new char, sugar-refiners are perfectly aware of its presence. The amount fluctuates between 5 and 10 per cent (dried at 160° to 180° C.), sometimes being as high as 15 per cent, and one sample which

I had occasion to analyse, the mean of twelve experiments, yielded the enormous result of 20.42 per cent of useless water. True such char is sold at a reduction in price, but I hold that new charcoal can be manufactured without this useless water, but probably at an increase in cost. The fact is the days of these deceptions are numbered, and, in a scientific age, the sooner intelligent sugar-refiners demand their char with a reasonable amount of moisture in it (say 2 per cent) the better for all parties.

With regard to the organic matter in new charcoal, I have been particular and exact in determining this constituent in many samples of animal charcoal which I have had occasion to analyse. Indeed, the importance of the work usually entrusted to me will not allow me to overlook its presence, and, as the result of my examination, I have found it to fluctuate between 0.01 and 0.5 per cent; never more in new charcoal, and in the stock char of sugar refineries, where soft water is used, it is frequently as low as 0.001 per cent, and even this is only detected after grinding the charcoal to absolute dust. In regard to these figures I believe I have the coincidence of chemists, bone-char makers, and sugar-refiners, who really possess a considerable amount of authority on the subject.

The presence of this organic matter is a source of great annoyance to modern sugar-refiners. A portion of it dissolves in water and in acid, while the remainder is totally insoluble in either menstruum. It may be detected by the following tests:—

(a). Heat some of the dry char in a dry test-tube, inhale the fumes; should they smell of burning organic matter the inference is clear as to its origin.

(b). Separate all the matter soluble in distilled water, evaporate the solution in a platinum basin, raise the temperature; should the residue *blacken* it proves that the carbonaceous matter is in an incipient state of combustion. Soluble organic matter is indicated.

(c). Place some of the char on a watch-glass, underneath which is a circle of filter paper, run some strong dihydric sulphate over it. Blackening indicates the presence of organic matter.

(d). Filter the acid through asbestos previously washed with the same acid, should a very dark liquor filter through.

(e). If a portion of the charcoal be boiled with solution of caustic soda, and a yellow or brown solution is obtained, the presence of organic matter may be inferred.

Charcoal when new frequently contains considerable quantities of caustic lime and many other small constituents, which should on no account be omitted; and in all cases qualitative analysis should be resorted to previous to trying quantitative analysis, and even microscopy will perhaps lead to the discovery of substances entirely foreign to new animal charcoal, such as common coal, road sweepings, old charcoal from sugar refineries, associated with old charcoal dust and many other things.

Following up these adulterations it is the duty of the chemist to detect and estimate them if possible, and at all events to clearly prove they exist there.

(1). To commence with the detection of common coal in presence of animal charcoal. This may be detected with advantage by aid of microscopy, comparing the effect with standard coal and bone-black respectively, or with absolute certainty by the following ignition test. Place some of the suspected char in a platinum crucible with the lid on (a porcelain crucible is more preferable), heat somewhat strongly, and observe your subject.

(a) Volatile matter is given off,

(b) Which enters into rapid combustion,

(c) And burns with a yellow smoky flame.

(e) Leaves a carbonaceous deposit on the inside of the lid.

(f) The residue may *cake*.

(2). Road sweepings may also be detected by the appearance of the charcoal under an ordinary microscope.

(3). The adulteration of old charcoal with new, of which the former, which is absolutely useless for sugar

refining purposes, and old charcoal dust, may be detected by the assistance of microscopy, or in the case of char dust by mechanical analysis and chemical combined.

Place some of the suspected char on a series of wire gauze sieves, such as are frequently used in sugar refineries in testing the division of charcoal, allow the dust to fall to the bottom of the apparatus, make a chemical analysis of both the charcoals, and ascertain their composition. This test is peculiar, because new animal charcoal and old spent material differ widely in their chemical composition, as also in their properties. The amount of carbon, water, iron, and alkaline salts, and organic matter are very constant in proportion in their respective samples, and tell at once whether the chars are identical. Thus new char does not contain more than 0.15 per cent of oxide of iron, whereas old charcoal contains as much as 0.30 per cent, and sometimes as high as 0.60 per cent. Again, the ash which a char leaves on ignition is a good indication of its age; thus new animal charcoal when genuine leaves a pure white ash; whereas old charcoal when ignited leaves a yellow or brownish ash, frequently cream coloured; and also the appearance of old and new char under a microscope can be distinctly distinguished. New charcoal is regular in division, and sharp round its edges, and black and velvety in appearance. Whereas old charcoal, from frequent revivification and manipulation in the sugar refinery, is confused and scattered in division, and broken and coarse round its edges, and has the appearance of time-worn stones. By these latter properties under the microscope it is easy to tell whether charcoal is mixed with old or stock char.

In working out these detections by means of the microscope the process will be highly facilitated by the help of standards. The presence of these frauds in animal charcoal is nothing new in connection with sugar refining, and I should only be too glad to add to my stock of information, so as to hold a position of advantage to detect and suppress them.

With regard to the amount of burning a charcoal should receive to meet the views of sugar-refiners, new foreign charcoal is often over burned, whereas home-made is as often under-burned; of both evils, the charcoal which is under-burned to a certain point, but not further, is to be preferred. Now when charcoal is over-burned the carbonaceous matter reacting on the calcic phosphate evolves free phosphorus; but in sugar refining, where upright revivifiers are employed, this seldom happens, the temperature being such as only to produce agglutination.

In sugar refining, where many samples of animal charcoal have to be examined to test revivification, it is indispensable that the method of bringing these samples to a rapid and also a very delicate test is of the highest importance both to sugar-refiners and also to chemists.

Having had frequently to keep pace with the revivifiers in a sugar refinery, I have found it an excellent test to find whether a specified char contains organic matter or not; if so the revivification process is scarcely complete, and should be repeated. The most delicate test which I know of, and which can be employed by any intelligent sugar-refiner, is—Place a *piece* of the charcoal under examination on the glass slide of a microscope and cover it with a *drop* of pure strong dihydric sulphate, allow it to stand for a short time, and then observe the effect through the microscope. Should organic matter exist in the char, even in the minutest trace, it will colour the acid brown, and the deeper in proportion. Many samples from the revivifiers may be tested in this way during a day.

These are facts in connection with the analysis and treatment of animal charcoal which are of the highest importance to chemists, and also to sugar-refiners who conduct their business on chemical principle, and are the observations of researches conducted for three consecutive years on the study of animal charcoal, both in the laboratory and in actual practice in the sugar refinery.

And, in conclusion, I regret that gentlemen connected with the Clyde sugar refineries, and elsewhere, rarely give

scientific journals the benefit of their enlarged experience; still should any interested parties take up the subject for study, they will find it to be an endless band of chemical facts; the more it is studied the more curious it is to understand; and, moreover, science has not yet grappled the difficulties which are to be met with in its treatment on a large scale in actual practice.

DETERMINATION OF SULPHUR IN PIG-IRON AND STEEL.*

By Dr. THOMAS M. DROWN.

THE method usually employed in accurate determinations of sulphur in pig-iron and steel is to treat a weighed sample of borings in a flask with muriatic acid, and to pass the gaseous products through an alkaline solution of lead or silver, which precipitates all the sulphur of the sulphuretted hydrogen in the form of sulphide of lead or silver. The sulphide thus formed is subsequently oxidised by aqua regia, bromine, or other oxidising agent, and the sulphuric acid formed precipitated in the usual way by chloride of barium.

I have substituted for the alkaline metallic solution, a solution of permanganate of potash in the strength of 1 gramme of permanganate to 200 c.c. of water, and find that it gives results quite as accurate as those obtained by using an ammoniacal solution of silver. By the employment of the permanganate, it will be readily seen, that there is a considerable saving of time and work. In order to test the accuracy of the method, six samples of pig-iron borings were weighed out (about six grammes each), and treated identically in the same way, with the exception that with three an ammoniacal solution of silver was used, and with the remaining three a solution of permanganate of potash. The sulphide of silver formed was filtered and oxidised by bromine water. The residues, after treatment with muriatic acid in the flask, were invariably filtered off and washed, then evaporated twice to dryness with aqua regia, taken up with muriatic acid, filtered, and the filtrate added to the main solution containing the sulphuric acid. In using the permanganate, I have found it necessary to avoid a very rapid evolution of gas. It is also necessary to pass the gas through at least three tubes or bottles containing the solution of permanganate. The gas then gives not the slightest blackening when passed into a lead or silver solution. After the evolution of gas has completely ceased, and air has been drawn through the apparatus for some time, the contents of the bottles are poured into a beaker, rinsed out with water, and any oxide of manganese adhering to the sides, or to the tubes, dissolved in a little muriatic acid. Enough muriatic acid is then added to the beaker to completely decompose the permanganate and convert it into a clear, colourless solution, in which the sulphuric acid may be directly precipitated. If the solution does not become perfectly clear, owing to impurities in the permanganate used, filtration is necessary before precipitation.

The following are the results obtained by the two methods:—

With Silver Solution.				With Permanganate.			
Per cent.				Per cent.			
No. 1	..	..	0.100	No. 4	..	..	0.093
No. 2	..	..	0.093	No. 5	..	..	0.098
No. 3	..	..	0.099	No. 6	..	..	0.091
The sulphate of baryta, after weighing, was fused with a little carbonate of soda and potash, and the sulphuric acid re-precipitated, giving—							
No. 1	..	..	0.0900	No. 4	..	..	0.0880
No. 2	..	..	0.0890	No. 5	..	..	0.0920
No. 3	..	..	0.0920	No. 6	..	..	0.0850
Mean.. .. 0.0903				Mean.. .. 0.0883			

The difference in the two means is but 0.002 per cent.

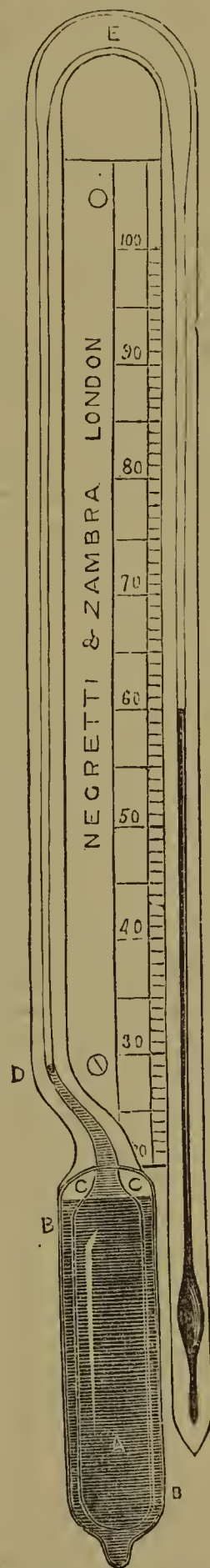
* A Paper read before the American Institute of Mining Engineers, February 28th, 1874.

The pig-iron used contained an unexpectedly small amount of sulphur. It was made from a brown hematite resembling a bog ore, occurring in vast quantities at Katahdin Furnace, Piscataquis County, Maine, containing 3 per cent of sulphuric acid.

NEW DEEP-SEA THERMOMETER.

MESSRS. NEGRETTI and ZAMBRA have recently communicated to the Royal Society the description of a new Deep-Sea Thermometer. For the purpose of ascertaining the temperature of the sea at various depths, and on the bottom itself, a peculiar thermometer was, and is, used, having its bulb protected by an outer bulb or casing, in order that its indications may not be vitiated by the

pressure of the water at various depths, that pressure being about 1 ton per square inch to every 800 fathoms. This thermometer, as regards the protection of the bulb and its non-liability to be affected by pressure, is all that can be desired; but unfortunately the only thermometer available for the purpose of registering temperature and bringing those indications to the surface is that which is commonly known as the Six's thermometer—an instrument acting by means of alcohol and mercury, and having movable indices with delicate springs of human hair tied to them. This form of instrument registers both maximum and minimum temperatures, and as an ordinary out-door thermometer it is very useful; but it is unsatisfactory for scientific purposes, and for the object which it is now used it leaves much to be desired. Thus the alcohol and mercury are liable to get mixed in travelling, or even by merely holding the instrument in a horizontal position; the indices are also liable either to slip if too free, or to stick if too tight. A sudden jerk or concussion will also cause the instrument to give erroneous readings, by lowering the indices if the blow be downwards, or by raising them if the blow be upwards. Besides these drawbacks, the Six's thermometer causes the observer additional anxiety on the score of inaccuracy; for, although we get a *minimum* temperature, we are by no means sure of the point where this minimum lies. Messrs. Negretti and Zambra have constructed an instrument on a plan different from that of any other self-registering thermometers. Its construction is most novel, and may be said to overthrow our previous ideas of handling delicate instruments, inasmuch as its indications are only given by upsetting the instrument. Having said this much, it will not be very difficult to guess the action of the thermometer; for it is by upsetting or throwing out the mercury from the indicating column into a reservoir, at a particular moment and in a particular spot, that we obtain a correct reading of the temperature at that moment and in that



spot. The instrument has a protected bulb thermometer, like a syphon with parallel legs, all in one piece, and having a continuous communication, as in the annexed

figure. The scale of this thermometer is pivotted on a centre, and being attached in a perpendicular position to a simple apparatus (presently described), is lowered to any depth that may be desired. In its descent the thermometer acts as an ordinary instrument, the mercury rising or falling according to the temperature of the stratum through which it passes; but so soon as the descent ceases, and a reverse motion is given to the line, so as to pull the thermometer to the surface, the instrument turns once on its centre, first bulb uppermost, and afterwards bulb downwards. This causes the mercury, which was in the left-hand column, first to pass into the dilated syphon bend at the top, and thence into the right-hand tube, where it remains, indicating on a graduated scale the exact temperature at the time it was turned over. The woodcut shows the position of the mercury after the instrument has been thus turned on its centre. A is the bulb; B the outer coating, or protecting cylinder; C is the space of rarefied air, which is reduced if the outer casing be compressed; D is a small glass plug, on the principle of Negretti and Zambra's patent maximum thermometer, which cuts off, in the moment of turning, the mercury in the column from that of the bulb in the tube, thereby insuring that none but the mercury in the tube can be transferred into the indicating column; E is an enlargement made in the bend, so as to enable the mercury to pass quickly from one tube to another in revolving; and F is the indicating tube, or thermometer proper. In its action, as soon as the thermometer is put in motion, and immediately the tube has acquired a slightly oblique position, the mercury breaks off at the point D, runs into the curved and enlarged portion E, and eventually falls into the tube F, when this tube resumes its original perpendicular position. The contrivance for turning the thermometer over may be described as a short length of wood or metal having attached to it a small rudder or fan: this fan is placed on a pivot in connection with a second; on the centre of this is fixed the thermometer. The fan or rudder points upwards in its descent through the water, and necessarily reverses its position in ascending. This simple motion, or half-turn of the rudder, gives a whole turn to the thermometer, and has been found very effective. Various other methods may be used for turning the thermometer, such as a simple pulley with a weight which might be released on touching the bottom, or a small vertical propeller which would revolve in passing through the water. Messrs. Negretti and Zambra have also adopted a very simple and inexpensive clock-work to their thermometer, and by these means an observer may have a record of the exact temperature at any hour of the day or night. We need hardly say of what utility the instrument will prove to meteorologists, and even manufacturers, to whom an exact record of temperature is of importance. Hitherto we have had no simple and inexpensive instrument adapted for this purpose: the thermograph in use at most observatories is an elaborate and expensive apparatus, which, in connection with photography, will record on paper the temperature during day or night; it necessitates the use of gas, or any artificial light, and of course is only available to persons who can have a building specially adapted for it.

PROCEEDINGS OF SOCIETIES.

NOVA SCOTIAN INSTITUTE OF NATURAL SCIENCE.

February 12th, 1874.

His Excellency Governor ARCHIBALD in the Chair.

THE Annual *Conversazione* of the Nova Scotian Institute of Natural Science was held on February 12th, at 7.30 p.m., when a large and fashionable assemblage filled the Long

Room and other apartments of the Custom House, the Inland Revenue Offices, the Geological Museum, and other rooms of the New Provincial Building, Halifax, N.S. The following programme was carried out:—

- (1). Dissolving Views Illuminated by the Oxyhydrogen Light. By Drs. De Wolfe and Warren.
- (2). The Sea-Abyssal Zone. By Dr. Honeyman, F.G.S.
- (3). Observations upon the Bones of a Fossil Whale found lately in New Brunswick, with restorations. By Dr. B. Gilpin, President.
- (4). Music.
- (5). Recreations in Natural Philosophy; chiefly Experiments on Air. By the Rev. Dr. Warren.
- (6). Chemical Relations of Heat. With experiments. By Professor Lawson, Ph.D., LL.D., Dalhousie College.
- (7). Promenade and refreshments.

The only address coming within the range of subjects embraced by the CHEMICAL NEWS was that of Professor LAWSON. It was devoted to some of the Chemical Relations of Heat.* He explained the nature of heat as a form of force, co-relative with light, mechanical energy, electricity, magnetism, and chemical affinity, showing that the one was convertible into the other. These forces influenced matter; upon the varying degrees of heat depends the condition of matter, whether it exists as a solid, a liquid, or a gas. Water is solid at low temperatures; when we give it more heat, raising the temperature to 32° , it becomes a mobile liquid; if the temperature be raised to 212° , the water has its condition changed to that of an invisible gas, which we commonly call "steam." As soon as the excess of heat above 212° is removed, the gas (or steam) passes back into the liquid state, and then, if further reduced (below 32°) into a solid, which is the present condition of all water in the open air in this part of the world, except in the deep sea and in deep lakes, &c., where it has not been cooled down to that temperature (in all still waters, however, a foot or two at the surface forms our ice-bridges and skating-ponds).

Illustrations were given to show that when a liquid passes into a gaseous state it absorbs heat, which it necessarily takes from surrounding bodies and makes them cold. Ammonia, ether, alcohol, vinegar, all readily volatilise, pass into the gaseous state; and the absorption of heat, to enable them to do so, necessarily produces a sensation of cold on the skin. The most remarkable body shown was sulphur dioxide, which, when poured on the back of the hand, evaporates instantaneously, produces intense cold, and freezes the flesh if used in too great quantity. The freezing of the hand in this way presents all the uncomfortable and dangerous symptoms of natural freezing at an excessively low temperature in an extreme climate. The evaporation of sulphur dioxide in a current of air produces a still lower temperature, freezing mercury, which does not solidify till the temperature goes down below 39° below zero. All these temperatures are of the Fahrenheit scale, the only one known in Nova Scotia except in scientific laboratories, where the Centigrade system is coming into use, and must in time prevail.

Professor Lawson entered into a full description of sulphur dioxide, which is always produced as a gas when sulphur is burned in the air or oxygen; it is also produced in the burning of coals containing pyrites or sulphide of iron, and by coal gas when it contains sulphur compounds; and the wilting of house plants, and probably the occurrence of coughs and colds in winter, are to some extent due to its occurrence in sitting rooms. Its old name is sulphurous acid gas. It is known also by the names of sulphurous oxide, sulphurous anhydride, &c., but everyone is familiar with it by smell, as that of the "smell" of burning sulphur. The Professor did not wish to burn

* "On some of the Chemical Relations of Heat, illustrated by Experiments on the Effects of Heat on Water and on Sulphur Dioxide." By George Lawson, Ph.D., LL.D., Professor of Chemistry, Dalhousie College and University, Halifax, N.S.

sulphur just at present, as the audience might soon have enough of the fumes. [The audience obviously misunderstood this remark, and His Excellency enquired whether it was meant as a compliment to the company that they would all smell sulphur soon enough; but the Professor explained that his remark referred only to the fumes of this evening.] He went on—The gas extinguishes flame, and the burning of sulphur is a common remedy for extinguishing a fire in the chimney. However, several metals will burn in the gas, decomposing it—as, for example, potassium, which forms polysulphide, sulphate, and thiosulphate; when simply heated to about 2200° , it is decomposed into free S and O. It has decided bleaching-properties, and is used for wool, silk, sponge, isinglass, and other animal substances that would be injured by chlorine; also for straw hats and willow baskets. A solution of the gas will remove fruit stains and wine stains from linen. It acts as a disinfectant, an antiseptic, and has been used in preserving meat; it is also an arrester of fermentation, on account of which wine and beer casks are sulphured, and sulphites are used in breweries and sugar factories. It preserves vellum and catgut. One of its most remarkable effects is that produced by its inhalation; it is not only irritating, like hydrochloric acid gas, and suffocating, like chlorine; but, when inhaled in a concentrated form, it *immediately* produces catarrh and sore throat, with all the ordinary symptoms of the natural malady, from which both the Professor and his assistants (Messrs. Lindsay and Stewart, medical students) had suffered more or less during successive investigations.

The gas is $2\frac{1}{4}$ times the weight of atmospheric air (sp. gr., 2.25). It is very soluble in water, which absorbs about 40 times its bulk of the gas at ordinary temperatures; the solution, when exposed to air in a bottle, changes slowly to solution of H_2SO_4 . At low temperatures a crystallised hydrate of sulphurous acid is obtained. In preparing the gas for condensation, the tubes must be kept dry, otherwise this hydrate forms in them and stops them up. At zero F., which may be readily attained by a freezing mixture of old frozen snow and salt (newly-fallen snow does not answer well, the sulphur dioxide gas is easily condensed to a liquid, which (at 60°) is 38 per cent heavier than water (sp. gr. = 1.38). The boiling temperature of this liquid, however, is 14° , and when in sealed tubes (if the temperature be raised to 60° , that of ordinary air) it exerts a pressure of $2\frac{1}{2}$ atmospheres. At between 105° and 110° below zero the liquid freezes into solid crystals, which are heavier than the liquid. A tube of the sulphur dioxide was placed on the hand of His Excellency the Lieutenant Governor, when the liquid immediately began to boil. Tubes were then handed round the room, so that every one might see the boiling by the heat of the hand. One lady succeeded so well in the boiling that, to her consternation, the tube exploded, and the cork was thrown in the air as from a pop-gun. To succeed perfectly in showing the boiling of the liquid dioxide by heat of the hand, it is necessary to have a twist of cotton, enveloping freezing mixture, around the top of the tube, to provide for rapid condensation; or the tube may be fitted with an encircling short piece of much wider tube at top to contain the freezing mixture.

The next experiment was a very remarkable one. A platinum crucible was made red-hot, the dioxide was thrown into the spheroidal state, water was added, and the red-hot crucible became filled with ice—the whole having cooled down in half a minute from red heat to a temperature far below freezing, and under favourable circumstances it would reach 40° below zero, so that even mercury could be frozen. This simple but striking experiment excited so much interest that after the close of the regular proceedings it was repeated over and over again to successive groups, who wished to watch closely the remarkable effects produced, and to handle the frozen crucible that had been red-hot within the same minute, and was cooled down in a warm room by simple evaporation over a spirit-lamp flame.

Professor Lawson, in referring to the great opportunities which we have in this climate of studying the effects of heat, exhibited a large bottle containing several pounds of glacial sulphuric acid that had separated and crystallised spontaneously from a solution of ferrous sulphate in oil of vitriol during the recent severe weather. The small portion of solution left in the bottle had a sp. gr. of 1.619.

At half-past nine the reading of the papers was completed, and the company dispersed to the various rooms, some in quest of the mineral and fossil departments, some to the tea and coffee rooms, some to the microscope and glass jars containing the tribute left by the *Challenger* on her visit to Halifax, and others in search of the bones of the fossil whale. The meeting was a very successful one, and has excited some scientific interest in the general community.

NOTICES OF BOOKS.

Journal of the Chemical Society. Containing the Papers read before the Society and Abstracts of Chemical Papers published in other journals. Edited by HENRY WATTS, B.A., F.R.S. London: J. Van Voorst. 1874.

Index to the First Twenty-five Volumes of the Journal of the Chemical Society, 1848-1872; and to the Memoirs and Proceedings, 1841-1847. Compiled by HENRY WATTS, B.A., F.R.S. London: J. Van Voorst. 1874.

THE Chemical Society of London has entered upon the fourth year of an enterprise unique, as far as we know, in the annals of a scientific society, and deserving the support of everyone connected with chemistry. The monthly Journal now contains, in addition to the papers read before the Society, abstracts of the chemical papers published in England, America, and on the Continent. Fellows of the Society, or annual subscribers of one guinea, are not only thus relieved from the necessity of taking in a large number of journals in order to ascertain what is being done in any department of chemistry, but they have the matter of the chemical communications placed before them in a condensed form. To those with but little spare time, or unacquainted with foreign languages, this is a great boon. The last annual volume may be taken as an example of the bulk which this valuable material occupies. We find that it contains nearly 1300 pages, of which by far the greater number are taken up by the abstracts, which amount to about 1400. These abstracts are prepared by some two dozen Fellows of the Society, aided by the Editor and a committee of publication.

We may state that technical chemistry comes in the second place as to the number of subjects treated of, the first place being occupied by organic chemistry; then follow papers on analytical, mineralogical, physical, inorganic, physiological, and agricultural chemistry. Our American and manufacturing readers will especially appreciate the usefulness of such a work. The expense of publication is very considerable, and is at present largely borne by a guarantee fund raised among the Fellows of the Society. The British Association has recognised the great value of this work by making a yearly grant of £100 towards its expense.

The Index to the Journal since its first issue in 1841 will also be found a most useful work, referring as it does to a period of such great activity in chemistry. Mr. Watts has not confined himself to a bare arrangement of titles, but has also referred, in many cases, to the different sections of the papers.

The Worthies of Cumberland. By H. LONSDALE, M.D. London: G. Routledge and Sons.

THIS work contains biographies of Wordsworth, the Blamires, Thomas Tickell, Dr. Thomas Addison, the Loshes of Woodside, and Hugh Lee Pattinson. The two last-mentioned names will chiefly attract the attention of

our readers. John Losh may be regarded as the fore-runner of the alkali manufacture on the Tyne. In conjunction with Earl Dundonald—the father, we presume, of the great admiral—he established alkali works at Bell's Close, near Newcastle, struggling manfully against the salt excise and its inconveniences. His brother, William Losh, took up the unfinished task, and lived to see the alkali trade of the north assume its present gigantic proportions—the result, in no small degree, of his skill, perseverance, and energy.

James Losh, another brother, afterwards Recorder of Newcastle, was mixed up in the controversy concerning the discovery of the safety-lamp. Sir Humphrey Davy wrote him a very peppery letter for having joined in presenting a service of plate to his rival, Stephenson.

The most remarkable and valuable memoir in the book, however, is that of Pattinson, the inventor of the world-famed process for separating silver from argentiferous leads, and otherwise one of the most able and successful practical chemists the world has ever seen; witness his oxychloride of lead, his improvements in the preparation of magnesia, his investigations on the electricity of steam, and his explanation of the Gateshead explosion.

We can most cordially recommend this work to all who feel an interest in the history either of applied science or of literature. Extracts numerous and interesting might easily be given; suffice it to say that, in addition to the subjects of his biographies, the author brings us in contact with Davy, Humboldt, Faraday, Stephenson, Dundonald, Coleridge, Jeffrey, Paley, and many other men of mark of the last century and the earlier half of the present. One circumstance strikes us, however, as remarkable:—The life of John Dalton has, indeed, been adequately written, still it is curious to find him entirely omitted in an enumeration of the worthies of Cumberland.

Fruits and Farinacea: the Proper Food of Man. By the late JOHN SMITH, of Malton. Edited by Emeritus Professor FRANCIS W. NEWMAN, for the Vegetarian Society. London: F. Pitman, Paternoster Row. 1873.

WE do not know whether vegetarianism be on the increase, and we cannot imagine that Mr. Smith's book will bring it more into vogue; for, although he attempts to prove that vegetables were the "original" and the "natural" food, and still constitute the "best" food of man, his arguments and proofs are in the main so unsatisfactory, that we are more inclined than ever to be omnivorous. The proof that vegetables were the original food of man are mainly taken from Genesis, Ovid, Pope, and Thomson; Hippocrates and Galen (who are called "eminent physicians") are quoted as authors of the statement that all early races "were perfectly natural and simple in their diet." Of course, before fire was known, man in his crudest and most barbaric state was compelled to live on the fruits of the earth, or on raw flesh, but we have no wish to go back to that state of semi-gorillaism.

If our author desires an ancient account of man in this early period, we refer him to Lucretius ("De Natura Rerum," lib. v., 930 *et seq.*), where he will find an account of the fruit-loving race. The earth, says Lucretius, then furnished plenty of whortle-berries, larger than those which now grow, upon which men lived, together with acorns and fine crab-apples; but the conditions and the mode of life there delineated is in good sooth anything but enticing. The men who lived on fruits, lived in caves, and clothed themselves with the untanned skins of wild beasts, when they could get them.

Next, our Author gives us the evidence from comparative anatomy to prove that man is not a flesh-eating animal. He assures us that our teeth are not adapted for the purpose: that in reality we have no pointed canine-teeth in our head, although we give them that name. Other arguments are drawn from our zygomatic arch, alimentary canal, stomach, colon, and cæcum, liver,

and perspiratory glands. In effect, he endeavours to show that we resemble the herbivora in the following respects:—

- (a). In the absence of claws and tusks.
- (b). In the joint of the lower jaw.
- (c). In the form of the cheek-arch.
- (d). In the considerable length of alimentary canal.
- (e). In the size and complexity of the other digestive organs.
- (f). In the number of the perspiratory glands.

Many other arguments, for the most part very irrelevant, are adduced in favour of a vegetable diet. In the comparison of the food of an Esquimaux with that of an Arab, no mention is made of the fact that the temperature of the blood of the former is the same as that of the latter, while the cooling causes are infinitely greater and the food requires to be adapted to the differences of climate. Some experiments are quoted in which men were fed daily on 2 lbs., 3 lbs., and 1 lb. respectively of potatoes for breakfast, dinner, and supper. We are not told how long the experiment was continued, but eight out of the ten men experimented upon gained weight, which is, perhaps, not to be wondered at when we remember that they were confined closely and had very light work to do. In another experiment, men were fed upon oatmeal, buttermilk, and potatoes; their work was very light, and we cannot wonder at the fact that they gained weight. But we should like to know how it was gained, or rather where the gain took place, and what was the condition of their muscles.

CORRESPONDENCE.

COMMERCIAL ANALYSES.

To the Editor of the Chemical News.

SIR,—In commercial analysis it is, I suppose, unavoidable that discrepancies should often occur between the results of the chemist for the buyer and those of the chemist for the seller. But even if this be the case it is well, perhaps, that when an analysis which appears absurd in itself is tendered in return for a fee, that the analyst should be invited to explain his results or refund the fee. A case in point has lately occurred, and as, after two applications for an explanation of the analysis, I have failed to obtain anything satisfactory, I now ask you to favour me by publishing the case, in the hope that some brother chemist may either supply the needed light to elucidate the results bought, or strengthen my own opinion of their inaccuracy.

A short time back some spent char was placed in my hands for analysis, a sample being also sent to a local chemist. The percentage of phosphate of lime only was required, and inasmuch as my own result was more than 2 per cent higher than that obtained by the buyer's chemist, a portion of identically the same sample was, by my request, sent to London to be analysed by a gentleman well known as having great experience in the examination of phosphates. The results of all three operators I append. No. 1, analysis by London chemist. No. 2, provincial chemist. No. 3, my own analysis.

	I.	II.	III.
Water and organic matter	17.50		18.4
Phosphoric acid	*32.83	73.9	{ 34.9 41.9
Lime	44.10		
Oxide of iron and alumina	—		0.8
Magnesia, carbonic acid, &c.	3.47		2.22
Insoluble siliceous matter	2.10		1.20

* Equal to tribasic phosphate of lime, 71.67

† " " " " 76.2

Now, Sir, setting my own results aside, and ignoring the estimation of phosphate of lime made by the local chemist, because it is an estimation of phosphoric acid only, I set seriously to considering the results offered by

the London gentleman. Phosphoric acid when saturated with lime is known to form a compound in which acid is to base as 71 : 84. And if we take the amount of phosphoric given in this analysis we shall find it will require 38.84 per cent of lime to form this compound. The total lime stated, uncombined with carbonic acid, is 44.1 per cent; thus there appears an amount of 5.26 per cent lime uncombined or combined with some organic acid. The substance is not alkaline to test-paper, hence the lime is not uncombined, and if the carbonic acid be estimated after ignition, and heating with ammonia carbonate, no increase of carbonic acid is found, hence the lime cannot be combined with an organic acid. The question is of some importance because it has become greatly the custom with analysts to report in phosphates an excess of lime, which does not show itself either by alkalinity of the ignited phosphate, or by an amount of carbonic or other acid sufficient to justify the statement that it is present.

If any of your readers could explain how the analysis No. 1 can, under the circumstances, be correct, and would kindly take the trouble to do so, I should feel much indebted.—I am, &c.,

EDMUND A. COOK.

12, Norwood Grove, W. Derby Rd.,
Liverpool, April 28, 1874.

VALUATION OF SALT-CAKE.

To the Editor of the Chemical News.

SIR,—Mr. Wm. Simmonds seems to have mistaken my object in communicating what I did to the CHEMICAL NEWS regarding salt-cake valuation. I only said it was the plan followed in a great centre of its manufacture, and hence some of the discrepancies observed in its analysis. I am perfectly aware that the process is far from perfect; but when I state that it is no uncommon thing for a chemist or his assistant to have ten or twelve samples of salt-cake to do *directly*, besides other work, it will be seen that it would be impossible to make an analysis such as Mr. Simmonds gives us for reference.—I am, &c.,

R. J. TINNISWOOD.

Radcliffe, near Manchester,
May 2, 1874.

ON THE CHEMICAL EXAMINATION AND COMPARATIVE COMPOSITION OF SOME SPECIMENS OF PRESERVED MEAT.

To the Editor of the Chemical News.

SIR,—I observe in the current number of your journal a paper by Mr. Ogilvie, in which he makes some statements which, to my mind, require some slight correction.

The method he prefers to adopt to obtain comparative results I do not purpose to criticise, seeing that these methods are but vague at best, and any mode of proceeding that may be adopted is useful for comparison; what I would do, however, is to correct the dogmatic statements which Mr. Ogilvie makes, and which I am sure he would not have done had he carefully considered some of the points to which I will now refer.

In the comparative table on page 182 it is stated that the "alcoholic extract" includes "creatin, inosic acid, lactic acid." Now creatin and inosic acid are not soluble in cold alcohol, and nearly insoluble in hot, and creatinin and sarkosin act in the same manner, so that these bodies would be in the "watery extract." In this last mentioned extract gelatin is included; was it a hot or cold extract, and as the numbers are so high for Liebig's extract was there any gelatin in the sample analysed?

Lower down the list we have the proportions of "fibrin or syntonin." Fibrin is an insoluble form of albumen undoubtedly, but syntonin is an acid-albumen obtained in a very different manner, and is soluble in dilute mineral acids.

There is no justification for the statement—"Thus fat is not only indispensable in the process of repair of all

cellular and fibrous matter, but is also necessary for the digestion of the other elements of food," for herbivorous animals take but little fat in the food they eat, yet they convert starchy matters largely to fat. And, again, seeing that the more important and greater part of the body is not "cellular or fibrous" it cannot matter whether fat is necessary for the repair of those tissues, though it is well known they neither of them contain fat.

A few lines below this the following expression occurs:—"As without them (the salts) the other bodies could not be ingested." How the absence of salts can affect ingestion I do not know; to ingest means to put into the stomach.

Further on Mr. Ogilvie falls into a greater error yet, or perhaps he has been misinformed on the subject. He compares the jelly of preserved mutton and Liebig's extract of meat with tea and coffee as nerve stimulants. He says they contain an alkaloid (?), creatin corresponding in chemical relationship with theine and caffeine. This is quite incorrect; in Strecker's researches on this matter the constitution of these bodies could not be harmonised, although it was thought possible they might belong to an homologous series, even when decomposition did not yield the same results.

These bodies—creatin, uric acid, urea, and lactic acid—are undoubtedly waste products of the animal economy. The fact that they occur in the urine in health shows that they are waste material, and their presence in muscle is merely an evidence that they are constantly in process of conversion, and of course are necessarily always to be found.

So far from exciting mental activity, urea and creatin produce coma, and lactic acid produces variously, if in excess, rheumatism, rickets, or mollities ossium.

That extract of meat is beneficial is still an unsettled point. Bogoslowsky (*Arch. f. Anat. u. Physik*, 1872, 347, 421) give some experiments on this subject, in which warm water acted in exactly the same way as extract of beef solution; and that large doses of extract killed the animal as did water containing the same proportion of mineral matter as the extract.

Apart from scientific evidence there can be no doubt that Australian preserved mutton is an excellent food. It is largely used in asylums, prisons, and workhouses, the inmates of which undoubtedly preserve their health and strength in a remarkable manner.

I trust that Mr. Ogilvie will regard these criticisms as they are meant, as a courteous explanation of errors, the which should always be corrected.—I am, &c.,

S. W. MOORE.

Physiological Laboratory,
St. George's Hospital, S.W.
April 30, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, March 16, 1874.

Note on the Employment of Flexible Laminæ for Tracing Arcs of a Circle of Large Diameter.—M. Resal.

Experimental Researches Leading to a Determination of the Temperature of the Sun.—P. Secchi.—The author sought to compare the solar radiation with that of the electric light. He used the thermoheliometer described in his work on the Sun. It is difficult to determine the surface of the radiating parts of the carbons, and he endeavoured to do so by comparing their dimensions with those of glass tubes placed very near, and estimating the distances

at which a platinum wire entered into fusion without touching them. Thus, a surface nearly rectangular was got, and the radiation of parts exterior to this limit was cut off by diaphragms. The temperature produced by solar radiation was determined about midday on several days in July, and with the same instrument. The difference was found 17.16° , or, with correction for atmospheric absorption, 17.37° . Substituting this in the formula, the solar radiation is given as thirty-six and a half times that of the carbon points. This estimate, however, is considered under the truth; and if we take M. Soret's direct estimate (on Mont Blanc) of 21.13° instead, then, supposing the temperature of the radiating surface of the carbons 3000° (which is not exaggerated), and supposing the radiation proportional to the temperature, we get, for the potential temperature of the sun, $133,780^\circ$. This might be even raised to $169,980^\circ$, if the figure of 27° were taken as produced by solar radiation. If the temperature of the sun reaches only some thousands of degrees, his cooling should be sensible in a comparatively short time, and the diminution of temperature should lead to a notable acceleration of the stars' radiation.

Report on Geodesic Works Relative to the New Determination of the Meridian of France.—M. de Beaumont (in name of Commission).—It is hoped, by completion of the work now in hand, to obtain the measure of an arc of meridian, which from the Shetland Islands to the Great Desert of Sahara will embrace more than 26° of latitude. This will furnish, for determination of the size and figure of the earth, a more extended base than any used hitherto.

Memoir on the Swimming-Bladder as regards Station and Locomotion of the Fish (continued).—M. Moreau.—A perch contracted (in volume) momentarily on a shock of electricity being given to it. It can also diminish its volume voluntarily; when making an effort, *e.g.*, to pass an obstacle. Such contractions are only of short duration, and are probably not utilised by the fish to change its density, and favour its movements of ascent or descent. The swimming bladder confines the fish in a zone, the middle of which corresponds to its normal volume, to that which the density of the water gives it. The bladder is a permanent source of danger to the fish. In fishing for whiting pont (*Gadus barbatus*) with a line not more than 2 to 3 metres long, the author found that all the animals brought up had their bladders ruptured.

Conditions Determining the Movements of Grains of Chlorophyll in the Cells of *Elodea canadensis*.—M. Prillieux.—The author distinguishes between movements, on which light has influence, in the intact plant, and other movements produced through lesion of the tissues. He thinks that the most natural way to explain the facts of observation is by supposing that the grouping of grains of chlorophyll is determined by attractions which they exert on each other, and which the membranes exert on them.

Laws of the Plane Distribution of Pressures within Isotropic Bodies in the State of Limited Equilibrium.—M. Boussinesq.

Friction of Glaciers and Erosion of Valleys.—M. Ch. Grad.—The author gives reasons for thinking that neither the valleys of the Alps, nor the lakes of Italy and Switzerland, nor the fjords of Norway and Greenland owe their origin to erosion by glaciers.

Symetric Isomerism, and on the Four Tartaric Acids.—MM. Berthelot and Jungfleisch.—The union of dextro-tartaric and lævo-tartaric acids to form the optically neutral acid in a solid state liberates $+4.43^\circ$. The mixture of the two acids in solution sets free only $+0.12^\circ$. It appears probable that these two acids remain almost entirely separate in their dilute solutions, and that water decomposes in great part the neutral acid into its two acid constituents.

Crystalline Hydrates of Sulphuric Acid.—M. Berthelot.—The author has been engaged, during the past

winter, with preparing a large quantity of the second crystalline hydrate of sulphuric acid. The large brilliant crystals were drained for eight days on a plate of biscuit-porcelain, and the heat developed during their solution was then determined. In presence of 200 H_2O_2 three experiments gave a mean of 3.56 at the temperature of 11.5° . The heat given off by the same acid melted, at the same temperature, and in presence of the same amount of water was 5.40 . Hence the heat of fusion of the bi-hydrated acid, $\text{SO}_4\text{H}_2\text{HO} = 1.84^\circ$.

Heat of Combustion of the Varieties of Red Phosphorus.—L. Troost and P. Hautefeuille.—The appearance of red phosphorus depends on the highest temperature to which it has been exposed. If prepared at 265° , it forms splendid red masses, with a vitreous fracture like that of realgar. If prepared at 440° it is of an orange shade, and its fracture is dull and granular. Above 500° it becomes more compact, and has a bright violet-grey colour. That obtained at 580° has a conchoidal fracture, and in thin layers it appears semi-transparent. Crystallisation commences in ruby-red particles, which recall the geodes of hyaline quartz found in agate. The specific gravity and the heat of combustion vary in a continuous manner in specimens formed at gradually increasing temperatures. The kind prepared at 265° has the specific gravity 2.148 , and its heat of combustion exceeds that of common red phosphorus by 320 calories per grm. Red phosphorus obtained at 360° has the specific gravity 2.19 , and its heat of combustion exceeds that of the crystalline red variety by 298 calories. That formed at 500° has the specific gravity 2.293 , and its heat of combustion is still higher than that of the crystalline kind. That obtained at 580° has a heat of combustion lower than that of the crystalline red variety by 50 calories.

Chemical Nature of the Sulphide of Iron (Troilite) contained in Meteoric Irons.—Stan. Meunier.—The author contests the view of Lawrence Smith that troilite is a simple proto-sulphide of iron, and regards it as a variety of Breithaupt's pyrrhotine, Fe_7S_8 . This opinion is founded on the results of the analysis of several troilites submitted to a previous purification. As a confirmatory test he finds that while a cold aqueous solution of the sulphate of copper is instantly reduced to metallic copper by the proto-sulphide of iron, troilite, like pyrrhotine, remains entirely unattacked under the same circumstances. Jannetaz has shown that in contact with an aqueous solution of the bisulphate of potash, proto-sulphides, such as galena, blende, &c., give off sulphuretted hydrogen, whilst nothing similar ensues if the sulphide has a different constitution. Treated in this manner proto-sulphide of iron gives off sulphuretted hydrogen, whilst with troilite no odour can be perceived.

Phosphate of Cerium containing Fluorine.—Radominski.—This paper has been already noticed.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 4, April, 1874.

Report made by M. Salvétat, in the Name of the Committee of Chemical Arts, on the Procedures for Weaving and Dyeing the so-called Lisieux Cloths, introduced by M. Theophile Grison, of Lisieux.—The description of the processes presents nothing definite. It is stated as a novelty that M. Grison had the idea of mixing with woollen refuse new greased cotton. "It is evident that oiled cotton acquires properties equivalent to those of this fibre when animalised." The cotton does not form the warp of the cloth, but is carded with the wool and spun together.

Discourse on the Modern Progress of Chemical Manufactures.—M. Aimé Girard.—This lecture was delivered in 1873 at the Lyons meeting of the French Association for the Advancement of the Sciences. The principal points have been already noticed in the CHEMICAL NEWS.

Bulletin de la Societe Francaise de Photographie,
No 2, February 1874.

At the meeting of the Society, February 6, it was stated that red glass was preferable to yellow for the windows of photographic ateliers.

History of the Preliminary Insolation of the Sensitive Layer.—M. Perrot de Chaumeux.—Gaudin, continuing the action of light upon a Daguerre's plate, by means of a screen of red glass obtained in a high wind images of clouds near the zenith in half a second. No accelerating substances were then known. A few weeks afterwards Becquerel, continuing his researches, found that yellow light was much superior to red upon sensitive paper. About the same time Fortier Senior obtained instantaneous proofs on operating in a camera the sides of which were of yellow glass. In 1843 Becquerel published the following passage:—"If we spread chloride of silver upon white paper, or upon any surface, and expose it in the spectrum, we see a reaction set in towards the extreme violet between the lines H and G of Fraunhofer, and extend on the one hand almost as far as F in the blue, and, on the other, far beyond the visible violet. But if the chloride of silver, after having been prepared in a perfectly dark room, is exposed for a short time to diffused or solar light, so that it may not be blackened, but that merely a very slight commencement of action may take place, and if it is afterwards exposed in the spectrum we see a colouration not only in the extreme violet, but an action appears at the same time in the least refrangible part of the spectrum towards the extreme red. Becquerel shows in the same memoir that the bromide, iodide, and, in general, all salts of silver undergo the same reactions. The discovery of accelerating substances drew away the attention of experimentalists from the practical application of these facts. We find, however, in a treatise on photography upon paper, published by M. Blanquart-Evrard in 1851, a chapter on the use of a camera whitened within. He declares that by this means the susceptibility of the plates can be increased more than one-half. In 1870 Constant recommends the use of a camera partially whitened within, according to the use for which it is intended. Bazin obtained an acceleration of one-third in time by introducing red light into the camera by means of a special aperture. Léon Foucault exposed his sensitised plates to the light of a Carcel lamp before placing them in the case. The employment of green light has been lately found very useful for the same purpose.

Second Note on Heliochromy.—M. de Saint-Florent.—If a sheet of paper, prepared with subchloride of silver as described below, and freed by washing from excess of hydrochloric acid, is placed behind a painting on glass, we obtain, after a short time, a negative proof presenting all the colours of the original. This image becomes positive if the exposure is prolonged. The paper is prepared by immersing good common paper in an alcoholic bath of nitrate of silver, prepared as follows:

Distilled water	20 parts.
Nitrate of silver	20 "

When the solution is complete, add—

Alcohol	100 parts.
Nitric acid	10 "

When taken out of this bath the paper is dried in a quire of blotting paper, and steeped in—

Hydrochloric acid (strength ?) ..	50
Alcohol	50
Nitrate of uranium	1
Chloride of zinc	2

In this bath the paper is left for some minutes, and exposed to light till it takes a violet-blue tint.

Gazzetta Chimica Italiana, Anno iv.,
Fascicolo 1 and 2, 1874.

Studies in Toxicological Chemistry.—Prof. Francesco Selmi.—An examination of the reactions applicable for the

detection of solanin and solanidin; of the methods for extracting organic alkalies from the viscera, and for detecting nicotin, brucin, and strychnin; and of the recognition of hydrocyanic acid.

Old and New Reagents for Common Phenol.—Egidio Polacci.—The author points out the distinctions between the blue colour produced by phenol and hydrochloric acid with a chip of fir-wood and that given by hydrochloric acid alone. The violet colouration given by perchloride of iron is indecisive as being common to all the phenols. The blue colouration given by the successive action of ammonia and a hypochlorite is less general. As this method turns on the conversion of the phenol into aniline by the action of ammonia, the test is only available where the absence of aniline is satisfactorily demonstrated. Cresylic acid and thymol yield similar results. In complex organic fluids the reaction may fail. The conversion of phenol into picric acid by the action of nitric acid cannot be used for the detection of the first mentioned body, since the same result is obtained with a great variety of bodies. The author pours into a narrow test-tube concentrated sulphuric acid to the height of 4 or 5 centimetres, and adds cautiously the aqueous solution containing the phenol, in such a manner that the two liquids may not mix. A formation of three colours is soon perceived at the line of contact of the two liquids. These three are soon reduced into one, a vermillion-red, which, setting out from the plane of division diffuses itself through the entire mass of the phenol solution. This colour is stable, and remains unaltered for months. If the red liquid is removed from the acid, and treated with an alkali, it becomes yellow without losing its transparency. This reaction serves to detect 1 part of phenol in about 2000 of water. Another method is as follows:—In a well glazed porcelain crucible is put a little of the most concentrated sulphuric acid, to which is added a relatively minute portion of bichromate of potash. The mixture is well stirred so that the liberated chromic acid may be uniformly distributed through the sulphuric acid. A small drop of the liquid under examination is placed upon the acid mixture, which immediately gives a brown colouration at the point of contact. If the proportion of phenol is larger than 1 part in 30,000 the colouration is accompanied with a chocolate-brown precipitate. The author has also examined Landolt's test, which consists in adding to the suspected solution bromine water in slight excess. If phenol is present a yellowish white precipitate is produced. The sensibility of this reaction extends to 1 part in 45,500. As Landolt has remarked, precipitates, more or less similar, are produced by oxybenzoic acid, the homologues of phenic acid, anilin, toluidin, quinin, quinidin, cinchonin, strychnin, narcotin, and morphin. The author considers that the yellowish white precipitate may be recognised as tribromo-phenol by the following reactions:—It has a special odour, slightly recalling that of the hydride of salicyl. It is insoluble in acids, but soluble in alkalies, ether, and absolute alcohol. A very small quantity of water completely separates tribromo-phenol from its alcoholic solution. If carefully heated on platinum-foil it may be volatilised unchanged without leaving a residue. But if the heat is strong the compound is decomposed and burns with a smoky flame, evolving much bromine, and leaving a carbonaceous residue. A portion placed in a porcelain capsule, and treated with sulphuric acid and bichromate of potash, produces a chocolate-brown colour, with the escape of bromine vapours. If the bichromate is dissolved in water, and the experiment conducted in a glass tube, with the application of heat, the liquid takes a fine green colour. If gently heated with nitre and concentrated sulphuric acid, it forms oily drops of a fine red colour, which burn, leaving a bulky carbonaceous residue.

A Product of the Condensation of Oxalic Aldehyd.—Ugo Schiff.—The author has obtained the compound $C_{12}H_{14}O_3$, which he names hydro-hexa-glyoxal.

Action of the Amides upon Phenols.—Dr. Icilio Guareschi.—A continuation of the author's former papers upon the subject.

Action of Sulphur upon Carbonate of Lime.—Prof. A. Cossa.—The author has repeated Pollacci's experiments on the formation of sulphate of lime by the action of flowers of sulphur upon carbonate of lime in presence of water and at common temperatures with a negative result.

Reduction of Chloride of Silver by mean of Hydro-sulphite of Soda.—G. Scurati Manzoni.—If a solution of hydrosulphite of soda is boiled with recently precipitated chloride of silver, sulphurous acid is given off, and there remains metallic silver in a state of fine sub-division.

Expansion of Fused Sulphur.—G. Pisati.—This lengthy paper, more physical than chemical in its character, is not adapted for abstraction.

Reagents for Phenol.—G. Tasca-Lanza.—The author, criticising Pollacci's paper on this subject, shows that thymol, benzilated phenol, essence of aniseed, &c., give the same brown colouration with chromic mixture as does common phenol.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in means or apparatus for extracting chlorine from chloride of lime. James Haithwaite, Brookfield Place, Belfast, Ireland. July 4, 1873.—No. 2318. The object of the invention is to facilitate the extraction of chlorine from chloride of lime. For this purpose the chloride of lime is placed in an air-tight cistern or chamber partly filled with water, and provided with one or more hollow shafts formed with hollow arms and capable of revolving, by which the chloride of lime contained in the cistern is agitated, and by a current of air passing through the shafts and arms the chlorine is extracted from the chloride of lime and mixes with the water, and the liquor when settled is drawn off for bleaching purposes.

Improvements in the manufacture of ferro-manganese and other metallic alloys, and in apparatus for that purpose. Alexander Browne, of the firm of Browne and Company, patent agents, 5, Southampton Buildings, Holborn, Middlesex. (A communication from the Foundries and Forges Company, Terre Noire, La Voulte and Bèsege, France). July 5, 1873.—No. 2335. The features of novelty of this invention consist in the application of a revolving furnace heated by gas or other means to the manufacture of ferro-manganese and other metallic alloys, also the mode of lining the furnace with carbon, magnesia, &c., and the special arrangement thereof, which allows it to be removed from the fire while it is charged.

Improvements in the treatment of natural phosphates for the purpose of obtaining what are commonly called artificial manures or fertilisers, and in apparatus connected therewith. Joachim Buquin Howard Howarth, engineer, Salford, Lancaster. July 8, 1873.—No. 2364. This invention consists in obtaining soluble fertilisers from phosphates by treating them with the fumes of burning pyrites or other sulphurous ores.

Improvements in the manufacture or production of paraffin oil. Edward Meldrum, Dechmont, Linlithgow, N.B. July 12, 1873.—No. 2407. This invention relates to the production of paraffin oil from coal or shale, and consists in effecting the distillation of coal or shale in a cupola or furnace similar to a blast-furnace, so constructed and arranged that the non-condensable or permanent gases from such distillation may be introduced above the place at which the air is admitted, in order that any free oxygen may combine with such gas before coming in contact with the products of distillation, and thus prevent their oxidation and destruction.

Improvements in preserving wood. John Clayton Mewburn, patent agent and consulting engineer, Fleet Street, London. (A communication from Alexandre Hatzfeld, Nancy, France). July 12, 1873.—No. 2411. The wood is impregnated with an insoluble salt which hardens it. The process may be carried into effect by boiling the wood in an extract of gallo-tannic acid, or by injecting this acid into the wood, and by afterwards boiling the wood in a solution of sulphate of iron. For oak the gallo-tannic acid may be dispensed with.

Improvements in the manufacture of sugar. Alexander Melville Clark, patent agent, Chancery Lane, Middlesex. (A communication from Louis Joseph Frédéric Margueritte, Paris, France). July 12, 1873.—No. 2413. This invention relates, firstly, to the purification of second- and third-quality sugars by adding the same to a saturated syrup of the first product at 35° Baumé, the mixture being worked up in a mixer, whereby the molasses adhering to the surface of the sugar is separated therefrom, and then passed to a hydro-extractor, a very white and pure sugar being obtained. Secondly, To accelerating and increasing the crystallisation of sugar, and extracting sugar from molasses by the employment of salts of soda, ammonia, baryta, lime, strontian, magnesia, manganese, iron, zinc, and other salts, which, when added to a saturated sugar solution will promote the more or less rapid crystallisation of the sugar contained.

Improvements in absorbing dilute chlorine, and in apparatus for that purpose. Walter Weldon, Abbey Lodge, Merton, Surrey. July 16,

1873.—No. 2449. This invention relates to the absorption, by means of any suitable milk or solution of an oxide or of a salt, of the chlorine contained in a mixture of that gas with other gases. I employ for this purpose a series of two or more vessels, each filled with the milk or solution to only a portion of its depth. I provide each vessel of the series with an agitator, by means of which I keep the milk or solution in motion, and project a spray of it into the upper part of the vessel. Supposing a series of five vessels, and calling them A, B, C, D, and E, I arrange them at different levels in regular succession, and so connect them that I can at will run off the contents of D into E, those of C into D, those of B into C, and those of A into B, and so, moreover, that the current of gases containing the chlorine to be absorbed can pass continually through the whole series of vessels in the opposite direction, or that from E to A. In passing successively through E, D, C, B, and A, this current of gases, as it grows weaker in chlorine, comes into contact with milk or solution continually less and less saturated therewith. When the contents of the vessel E have absorbed sufficient chlorine, they are run off, those of D being then run into E, those of C into D, those of B into C, and those of A into B, and fresh milk or solution into A.

Improvements in the manufacture of artificial manure, and in apparatus employed therein. Edward Charles Hamilton, Colchester, Essex, and William Richard Preston, Harold Court, Romford, Essex. July 16, 1873.—No. 2450. According to this Provisional Specification, sewage is mixed with or filtered through waste wool, wool-dust, or shoddy, and the materials are brought to a pulverulent form.

The clarification and purification of sewage, and the discharges of polluted waters from paper-mills, printing-works, dye-works, and factories, by means of precipitation. Frederick Jacobsen, merchant, 1, India Buildings, Victoria Street, Edinburgh. July 16, 1873.—No. 2454. 1. Utilising as a precipitant the sludge or refuse obtained after the ley-water of paper-mills has undergone the soda-recovering process. 2. The re-use of the sludge obtained after such process for the precipitation of polluted waters. 3. For accelerating subsidence, the use, in combination with such sludge or refuse as respectively before-mentioned, of common salt, sulphate of zinc, chloride of iron perchloride of iron, either singly or jointly, in a solid or soluble state.

NOTES AND QUERIES.

Chicory and Coffee.—I should be glad if Mr. Allen would further explain his formula, given in the CHEMICAL NEWS, vol. xxix., p. 140, for calculating the quantities of these substances in a mixture of them from the density. What is 1020.6? and why is the product of that, minus the density found $\times 100$, divided by 12?—A. B. C.

Action of Chloroform on Iodoform.—20 grms. of chloroform were mixed with 0.2 grm. of iodoform; as chloroform contains often free chlorine, the chloroform was tested with potassium iodide, and the result proved the chloroform quite pure. The bottle with CHCl_3 and CHI_3 was exposed to the action of sunlight for about half an hour, after which the chloroform received a red tint, proving that free iodine was in solution. This solution was placed in an evaporating-dish, and, on evaporating the solution, a grey substance was received, giving with starch a blue, and with carbonic disulphide (CS_2) a red tint. During the action of CHCl_3 on CHI_3 , a gas was evolved, which, on being analysed, the presence of methyl hydride (CH_4) was apparent. The results from these experiments are that iodoform by the action of chloroform gives free iodine and methyl hydride.—SERGIUS KERN, St. Petersburg.

The Aqueous Solution of Phosphorus.—Four months ago, 25 grms. of phosphorus were placed in a black flask with 40 grms. of distilled water. With this water, the following experiments were made:—1. 10 grms. of this water were filtered and evaporated in a sand-bath: the residue were small pieces of phosphorus; immediately when dry they ignited. 2. A small quantity (5 grms.) of this water was evaporated till only half of the original quantity remained; some nitric acid was then poured, to change the P in solution into phosphoric acid, which was tested then with ammonium molybdate. A yellow tint and crystalline powder was received, showing that phosphoric acid was in solution. These experiments prove that phosphorus dissolves in water if a sufficient lapse of time be allowed.—SERGIUS KERN.

MEETINGS FOR THE WEEK.

SATURDAY, 9.—Physical Society, 3. Dr. Rae, "On Certain Physical Properties of Ice." Dr. Stone, "On the Fall in Pitch Occurring in a Strained Wire through which a Galvanic Current is Passing." Prof. Guthrie, "On an Absolute Galvanometer."

MONDAY, 11.—Society of Arts, 8. Cantor Lectures. Frederick Barff, M.A., "On Carbon and Certain Compounds of Carbon (Lecture V., Coal-Gas, its Composition and Purification, and Illuminating Properties.)"

— Royal Geographical, 8.30.

TUESDAY, 12.—Civil Engineers, 8.

— Photographic, 8.

— Anthropological Inst., 8.

WEDNESDAY, 13.—Society of Arts, 8. Major-General Synge, "On the Importance of a Special Organisation for the Diffusion of Sanitary Knowledge."

— Geological, 8.

ERRATA.—Pp. 180, 181. Paragraphs (1), (2), (3), (7), for grains read grammes.

THE CHEMICAL NEWS.

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ANALYSES OF SCOTCH GOLD.

By A. H. CHURCH.

THROUGH the kindness of Mr. Dudgeon, of Cargen, Dumfries, I secured for analysis some clean grain gold which had been lately washed from a burn at Wanlockhead. Mr. Dudgeon has collected a great deal of interesting information about the auriferous districts of Scotland, and their produce of the precious metal. I do not, however, purpose discussing these points on the present occasion, but merely offer the results of my analysis of the particular specimen of Scotch gold to which reference has just been made.

I also add an assay of another piece of Scotch gold (from Sutherlandshire). This specimen was secured for me by Dr. McNab, while the assay was very kindly made by Mr. G. H. Makins.

		In 100 parts.	
		Wanlockhead.	Sutherlandshire.
Gold	.. ..	86.60	79.22
Silver	.. ..	12.39	20.78
Iron	.. ..	0.35	—
Sp. gr. at 16° C.		16.50	16.62

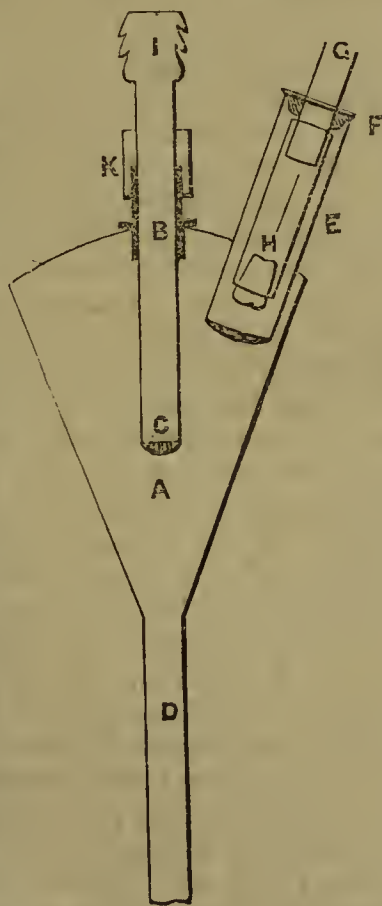
AN IMPROVED VACUUM FILTER-PUMP.

By W. JESSE LOVETT.

THOSE who have used the filter-pump described by Dr. Thorpe in his text-book of analysis know that the length of tube is objectionable in many cases, not only in use, but by reason of the room it takes in packing up. The form described below is intended to avoid this difficulty.

In the figure, A represents a cone turned up out of sheet metal, with a convex metallic cover. In the centre of this cover is soldered the outer ring of an ordinary screwed neck, such as is used in ordinary oil-can nozzles. To the inner ring of the neck is soldered a short brass tube, B, having a longer tube, I C, sliding tightly within it. The end, I, of this tube has a flexible pipe attached from the water supply, and the other end, C, has a piece of brass, drilled with a number of small holes, and fitted in to form a rose-jet. A tube, D, is fitted to the apex of the cone to carry away the water; and at one side of the cover is soldered a wide brass tube, E, having a screw-neck, F, holding a short narrow tube, G, on which is fitted one of Dr. Thorpe's admirably simple and efficient valves, H, consisting of a rubber tube with a slit in its side, and closed at one end. This allows air to enter the cone, but will not let any air leave it.

The screwed parts run down tight on leather washers to ensure their being air-tight, and the sliding part, B, is



covered at K by a piece of rubber tube for the same purpose. If now the apparatus be connected to the main, and the water turned on, a constant rush of water is kept up through the rose, C, into the apex of the cone, A, and in so doing forces a quantity of air out of the cone down the tube, D. This exhausts the chamber, A, creates a difference of pressure at the valve, H, which opens and lets air in from outside; and if connected to a filter and flask, will cause a considerable suction beneath the filter, and so hasten the passage of liquid through. There was a good supply of water where the apparatus was tried, and the suction was so strong as to burst single papers, necessitating the tap being only partially turned on. The following are the results of two experiments tried, the first with a small filter, the second with a large one:—

	Expt. I.	Expt. II.
With pump	1 m. 34 s.	6 m. 50 s.
Without pump ..	4 m. 40 s.	35 m. 30 s.

The time is that taken to empty the filter in each case.

This apparatus may be made applicable to a water blowpipe by passing the tube, D, into a three bored rubber stopper fixed into a bottle, and provided with two other tubes, one to carry away the air to the blowpipe jet, the other to carry away the waste water through an adjustable orifice, as used in the blowpipe devised by Mr. Mills of Birmingham.

PRELIMINARY NOTE ON A NEW METHOD OF SEPARATING CALCIUM FROM MAGNESIUM.

By E. SONSTADT.

It is generally known, being, indeed, stated by Fresenius, that when, from a solution containing calcium and magnesium, calcium is precipitated as oxalate in the usual manner, a proportion of magnesium accompanies the calcium precipitate, however large the proportion of ammoniacal salts present may be. It is not so well known that calcium is not completely precipitated under such circumstances, but that a certain proportion is held in solution by the influence of the magnesium salts. I have found that a solution of chloride of magnesium containing calcium, treated with oxalate and chloride of ammonium and ammonia, and filtered after two or three days, gives a solution which, evaporated to dryness and ignited for a long while, to drive off ammoniacal salts (much chloride of magnesium also volatilising), gives a residue from which water extracts, besides chloride of magnesium, some chloride of calcium. This is easily proved by adding pure oxalic acid in large excess to the solution of the residue, collecting after two or three days the precipitate that forms and heating it in a platinum crucible for an hour at a high temperature. The residue, digested in recently boiled water in a close vessel, gives a solution of hydrate of calcium the recognition of which presents no difficulty, since there is now a solution containing calcium with only a trace of magnesium to deal with.

Thus, in the ordinary method of separating calcium from magnesium, the result can only represent the truth by a fortuitous balancing of errors, the magnesium thrown down with the calcium being taken as compensation for the calcium retained in solution. Those more careful experimenters who re-precipitate their calcium two or three times, must necessarily get a result sensibly too low, and in no case is it possible to place any reliance upon the accuracy of the process.

Some years ago I suggested the use of tungstate of sodium for the separation of calcium from magnesium. When a perfectly neutral solution can be used, and when other alkaline salts are absent, or present in small proportion, tungstate of sodium throws down the calcium very completely, and perfectly free from magnesium. Yet, even when these exceptional conditions can be realised, it remains

practically impossible to estimate the magnesium, since, when the filtrate, even after separating the tungsten as far as possible, is treated with an alkali phosphate and ammonia, tungsten may always be detected in the precipitate. This process, therefore, can never be of general utility, although I have found it very convenient in special cases.

In the course of recent experiments on the iodates, I have found that iodate of calcium is not sensibly soluble in a saturated solution of iodate of potassium, whereas iodate of magnesium is not precipitated from solution in any degree by iodate of potassium. If to 10 or 12 c.c. of a saturated solution of iodate of potassium a few drops are added of solution of sulphate of calcium, and after two hours the liquid is filtered, and oxalate of ammonium added to the filtrate, a slight opalescence appears after a while, due to the presence of a trace of calcium. But if the iodate of potassium solution to which the calcium salt was added is allowed to stand twenty hours, and is then filtered, and oxalate of ammonium added to the filtrate, not the slightest opalescence appears even after many hours. A slight crystallisation takes place, owing to a diminution of the solubility of the iodate of potassium by the presence of oxalate of ammonium, but the crystals entirely disappear, leaving the solution perfectly limpid, on addition of a very small proportion of water. The precipitation of calcium by saturation of the solution with iodate of potassium does not appear to be affected by the presence of alkali and magnesium salts, in whatever proportion these may be present. If, for instance, a small quantity, as a decigramme, of ordinary Epsom salts is dissolved in the least possible quantity of water, and four or five times its bulk of a saturated solution of iodate of potassium is added, after a few hours a crystalline precipitate forms, which may be collected on a filter, washed with solution of iodate of potassium, dissolved off the filter with dilute hydrochloric acid, and, minute as the quantity of calcium present is, it may be shown immediately by the precipitate falling on addition of ammonia and oxalate of ammonium to the strongly acid filtrate.

In separating calcium from magnesium, by precipitation of the former by iodate of potassium, it is obviously important, in view of the subsequent determination of the magnesium, to know if the presence of iodate of potassium hinders the precipitation of magnesium as magnesium-ammonium phosphate. So far from this being the case, I find that the double phosphate is even less soluble in a saturated solution of iodate of potassium containing some free ammonia than it is in a mixture of two parts ordinary "liquor ammoniæ" with one part of water. Thus, the addition of solution of iodate of potassium to the ordinary liquid containing phosphate of an alkali and much free ammonia, over precipitated magnesium-ammonium phosphate, renders the fluid at once opalescent, and occasions an additional precipitation of magnesium salt.

I may mention here, that I have never met with a specimen of any magnesia or magnesium salt in commerce, although sold as chemically pure, that did not contain a very sensible proportion of calcium. I believe the only available source of a magnesium salt that shall be free from calcium is distilled magnesium; in this, I have never found any trace of calcium.

ON SOME

RECENT PROCESSES FOR THE MANUFACTURE OF SODA.*

By C. W. VINCENT, F.C.S.

THE object of this paper is the comparison of the principles involved, upon which Le Blanc's, our present, mode of soda-making is founded, with those of the more important processes designed to supplant it; and, in addition,

to point out to chemists and inventors generally, by the example of this industry, that scientific correctness alone is insufficient to secure success.

The failure of only too many chemical processes arises from the want of technical skill on the part of their devisers, and also frequently from the abundance of technical skill bestowed on the operations they are desired to supersede. This is emphatically the case with those processes which have been designed with the view of replacing our present mode of soda-making.

There are some few remarkably brilliant exceptions, but as a rule the chemist misses his mark when he goes beyond the principles of a process, and endeavours to plan the apparatus and plant by which it is to be carried out on a large scale. Mechanical facts and economic facts are just as true as chemical facts; where the three fit together, the structure is firm and strong; if they do not fit—and, in the hands of unskilful builders, this is always the case—the result is merely a jumble of materials which the first shake reduces to ruins.

The labours of the technologist are apt to be overlooked, though not in this Society, which has ever done honour to those who successfully perform, as well as to those who successfully plan.

A scientific principle is of immense value. To use the language of Dr. Tyndall, "The man who has thoroughly mastered a scientific principle holds a key which opens many locks." And here we must distinguish between that which is a true scientific principle and that which is mere theory. A theory rests upon isolated and scattered facts; remove one, the theory falls to the ground. But a scientific principle is founded on a mass of facts tending to one common centre; the observer may stand with security on the summit of such a pyramid, and rejoice and profit by the more extended view he obtains. But who collects the facts? The experimenter. The mighty intellect grasps and arranges, but the skilful hands execute science. So also in the arts. Science, whether chemical or physical, while never losing sight of details, merely uses them as so many means to an end,—views them as the many leaves of a tree, important as a whole to its life and well-being, and distinctive of its species, but individually of little worth. Technology, on the other hand, spends its entire energies on perfecting details; not a leaf of the tree must be neglected, but each must be tended and cherished so that the tree may be the best of its kind.

The importance of a technical education is now being estimated at something more nearly approaching its true value, and much of this is undoubtedly due to the action of the Society of Arts, which, amidst the many outcries as to what should and what should not be the course pursued, has laid down a simple system that cannot fail to be successful, because it is true to the end to be accomplished. The examinations are threefold—1. In those branches of science, a knowledge of which is requisite as a foundation for technical instruction. 2. The technology of the manufacture in question, *i.e.*, the special application of the various branches of science to it. (We are too apt to call ourselves technical chemists, because we know the look of the apparatus used in a factory, and know the chemical theory of the process, but we ought also to know the physics of the process, and the mechanics of the plant). 3. Practical skill in the manufacture itself.

Technical education to be valuable must cover a wide range of subjects. No trade contains within itself the means of development and extension; as soon as a need is felt—and appreciation of the need is the mark of the inventor—he must seek outside the trade itself, in other arts and amongst other principles of science than those already involved, for the means of supplying that need. Those trades stand still which do not take advantage of such things in other trades which have a bearing on their own business.

The technologist should have a knowledge of every practical art. This is of course impossible; but that which is possible, that which should be put within the

* A Paper read before the Society of Arts, Chemical Section, April 10, 1874.

reach of everyone, is a complete knowledge of the fundamental laws of mechanics, physics, and chemistry, as a foundation upon which to build all the special knowledge bearing upon the special pursuit to be pursued.

The prosperity of the iron trade is due to technology, as distinguished from chemistry.

The immense advances that have been made in smelting iron in the blast-furnace may be taken as entirely due to the improvements in the appliances used. Dr. Schweinfurth writes that savages in the heart of Africa make iron equal in quality to our best forged iron, the difference being that they make by pounds while we make by tons. But are our workmen much better instructed as to the principles of the process? It is only of late years that our iron-masters have penetrated into the arcana. The late researches of I. Lowthian Bell and C. R. A. Wright show how very far from accurate was the explanation of what took place within those igneous mountains.

The alkali trade owes its existence to the chemist, and its continued prosperity to his continuous oversight of the processes involved. The utilisation of the waste products—which began with the conversion of the hydrochloric acid into bleaching-powder, and has continued, step by step, until even the peroxide of iron in the burnt ore is rendered a valuable product—is entirely due to the close attention which has been paid by chemists to every reaction taking place amongst the constituents of the new material. Hence the great esteem, the high honour, bestowed on chemistry in the alkali trade. But this is only part of the truth as regards the success of this vast industry. Had not the chemistry been aided at each step of each process by technology, the vast progress made would have been impossible.

The chemical interchange which takes place when coal, lime, and sulphate of soda are roasted together, was recognised by Le Blanc, and worked out by him on what was considered a commercial basis; but so inefficiently were the mechanical and physical wants of the reaction supplied, that for a time the process was laid aside, its inventor subsisted on the charity of the English (to him a foreign) Government, and eventually died in a hospital.

Chemically, the process was entirely successful, the demand for soda was very great, and the price high; but the chemist was then unaided by the technologist.

Little more than half a century ago, the manufacture of soap and glass, the fictile arts, as well as those of bleaching and dyeing, the production of paper, were dependent upon the soda derived from soda-yielding plants, such as barilla and kelp, for their successful prosecution.

The kelp from Scotland alone was estimated at more than 15,000 tons annually; and, even as late as 1834, barilla to the amount of 12,000 tons was imported annually from Spain.

The price of kelp containing an average of 3 per cent of alkali was, at the close of the last century, £11 per ton. This price would render a ton of soda-ash worth £180—evidently a very large premium for the introduction of a new process.

The present price of soda averages £8 per ton, and economy in manufacture has been so studied in every branch of the process, that the premium for a new method is so small as to constitute one of the greatest difficulties that those reactions proposed to supplant our present mode of soda-making have to contend with.

The only method employed, as late as a hundred years ago, in bleaching the British-made linens and calicoes, &c., after boiling them in leys from kelp, was to saturate them with sour milk, and expose them for long periods to the action of the air; but, on account of the uncertainty of the climate, it was necessary that the best cloths should be sent to Holland, and, after a summer's absence, they were returned for use in England.

Writing-paper was made from the whitest rags, and the cost of the alkalies was as great as that of bleaching.

Both at home and abroad, the demand was so great that there was an absolute necessity of obtaining artificial soda.

France being then at war with almost every other Continental nation, all her external supplies of potash, soda, and nitre were cut off. Under these circumstances, in 1792, an inquiry was instituted by the Government as to the best method of manufacturing soda from common salt.

The idea was not a new one. Nearly all great discoveries have to be shared amongst many investigations; the greatest honour being given to that man who, from the first crude imaginings and imperfect workings, elaborates a really practical plan.

From a very early period it was found that common salt, sodium chloride, NaCl, was too stable a compound to be directly attacked by carbonic acid. Sodium chloride was, however, easily converted into sodium sulphate by sulphuric acid; and the sulphate, being a more manageable body, was, so early as 1777, looked upon as a possible source of soda carbonate by Malherbe.

In 1781, Mr. Brian Higgins decomposed common salt with oil of vitriol, roasted the dry sulphate with one-eighth of its weight of coal in a reverberatory-furnace, until the sulphate was reduced to sodium sulphide. Iron, lead, or other metallic oxides were then introduced, and caustic soda was obtained. It may here be remarked that patents for this process have been repeatedly taken out within the last few years.

The employment of metals or metallic oxides presented so many difficulties that no great commercial success was possible. It was at this crisis that Le Blanc, by substituting lime calcic oxide for the other metallic oxides, converted Malherbe's and Higgins's process, from what was little more than a chemical curiosity, into what has since become a great industry.

It was about this time that vitriol began to be manufactured on a large scale. Sulphuric acid had hitherto been made by distillation from copperas, iron sulphate. Chemistry devised a reaction by which sulphurous acid from burning sulphur should be oxidised to sulphuric acid by nitrous fumes.

Mixed sulphur and nitrate of potash suspended on an iron tray, in large wide-mouthed glass globes, partly filled with water, were set fire to by a red-hot iron, and the mouth was then closed. As soon as the charge was burnt out, another took its place, till the acid was found to be sufficiently strong, when it was removed into a glass retort, and concentrated much in the same manner as at present. This acid was sold for 2s. per pound, and was in much demand, on account of its purity, for several years.

This is all that chemistry has done for vitriol-making, with the exception of substituting pyrites for sulphur.

The technologist has to be credited with the next steps, which were the substitution of leaden chambers for the glass globes, burning the sulphur and the nitrate of potash outside the chambers, and sending in steam, instead of depending on the layer of water.

These changes apparently involve little genius or inventive skill, but without them the present eminence of vitriol-making, and through it of the alkali trade, as a commercial industry, could never have been attained.

(To be continued).

Analysis of Superphosphate, &c.—We are desired to state that at a recent meeting of the Chemical Section of the Philosophical Society of Glasgow, the following resolution was unanimously adopted (it was suggested by the paper read by the President of the Section, Mr. E. C. C. Stanford, which appeared in the *CHEMICAL NEWS*, vol. xxix., p. 190):—"That the Chemical Section of the Philosophical Society of Glasgow request the Committee of Section B of the British Association, at their next meeting, to appoint a sub-committee to inquire into the processes employed in the commercial analysis of superphosphates and salts of potash and soda and the statement of results."

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 7th, 1874.

Dr. ODLING, F.R.S., President, in the Chair.

THE minutes of the previous meeting had been read and confirmed, Messrs. J. A. Fleming, Robert Routledge, and W. Kellner, were formally admitted Fellows of the Society.

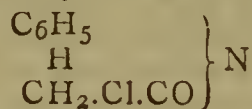
The list of donations was then announced, and the following names read for the first time:—Messrs. Henry Ird, John Taylor Leighton, William M. Habinshaw, Percy Tarbutt, Robert Yates, Toraske H. Tono, and Stephen Cooke.

The gentlemen elected Fellows of the Society after their names had been duly read the third time, were—Messrs. John McLachlan Glassford, George Jarman, Arthur Brotherton Allen, and Maurice Lichtenstein.

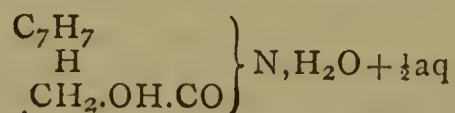
The first paper, "*The Action of Ammonia on Phenyl and Cresyl Chloracetamide*," was read in French by the author, Dr. D. TOMMASI. When phenyl chloracetamide is gently heated with a solution of ammonia in dilute alcohol, ammonium chloride is formed, which partly crystallises out. On removing this, and pouring the filtrate into cold water, a viscous product separates, somewhat resembling colony in appearance, and having the formula—



the chlorine in the phenyl chloracetamide—



having been replaced by hydroxyl. It is therefore isomeric with phenyl glycol. *Phenyl-hydroxyl-acetamide* is insoluble in cold water, and partly decomposed by boiling water into aniline and a new product. Alkaline solutions produce a somewhat similar decomposition. Phenyl-hydroxyl-acetamide is insoluble in hydrochloric and sulphuric acids, but soluble in glacial acetic acid. Heated with nitric acid, it dissolves, with evolution of nitrous fumes, and the addition of water to the solution produces a pale yellow precipitate. *Cresyl-hydroxyl-acetamide*—

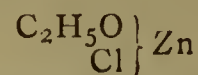


is obtained by a process similar to the phenyl compound, which it closely resembles in its properties and reactions. An attempt to prepare the corresponding naphthyl compound was unsuccessful.

The PRESIDENT, in thanking Dr. Tommasi in the name of the Society, remarked that an aqueous solution of ammonia usually acted on these chlorine compounds in the same way as the dry gas, replacing the chlorine by NH_2 , but the action here appeared to be entirely different, and more like that with potassic or sodic hydrate, introducing hydroxyl in the place of the chlorine.

Dr. GLADSTONE then read a paper, entitled "*Researches on the Action of the Copper-Zinc Couple on Organic Bodies (Part VII., On the Chlorides of Ethylene and Ethylidene)*," by J. H. GLADSTONE, F.R.S., and A. TRIBE, F.C.S. The ethylidene chloride employed boiled at 61° , and its density at 13° was 1.201; the ethylene compound had a density of 1.272 at 14° ; and the refraction equivalent of the two compounds was almost identical—namely, 34.6 and 34.5. The dry couple has but little action on either chloride; in the presence of alcohol, however, the ethylidene compound was attacked near its boiling-point, a gas being evolved, which consisted of ethyl hydride accompanied by a little

ethylene, and a viscid compound formed which is zinc chlorethylate—

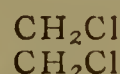


The behaviour of ethylene chloride was very different, but little gas being given off, and no zinc chlorethylate formed.

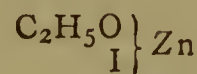
The PRESIDENT said they were glad to receive this new contribution on the action of the copper-zinc couple, showing, as it did, such a well-defined distinction between these isomeric chlorides, although it did not seem to afford an interpretation of the difference in their constitution—that is, that in one case H_2 in one of the methyl residues is replaced by two of chlorine—



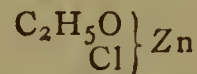
whilst in the other one hydrogen in each is replaced by chlorine—



Dr. GLADSTONE replied that as ethyl iodide gave the compound—



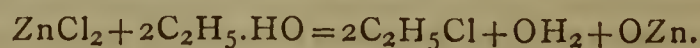
so the ethylidene compound, the chlorinated ethyl chloride, gave—



whilst the ethylene dichloride, when treated with zinc, split up into ethylene and chlorine.

Mr. CHARLES E. GROVES read a "*Note on the Preparation of Ethyl Chloride and its Homologues*." The author, after having noticed the defects of the principal methods given in the chemical manuals for the preparation of ethyl chloride, gave an account of the various processes he had tried for preparing the ether in quantity. Passing hydrochloric acid into boiling alcohol, or into boiling alcoholic solutions of calcium chloride, sulphuric acid, and ferric chloride, all yield ethyl chloride, but accompanied by considerable quantities of hydrochloric acid. If, however, a solution of zinc chloride in about twice its weight of alcohol be treated in the same way, in an apparatus where the alcohol vapour is condensed and flows back again into the flask, the hydrochloric acid is completely absorbed by the boiling liquid, while pure ethyl chloride issues at the other extremity of the apparatus. This continues until the whole of the alcohol has been converted into the ether. Wood-spirit and amyl alcohol, when treated in a similar manner, furnish pure methyl and amyl chlorides. Phenol and cresol are unacted on. [The apparatus employed for the preparation of ethyl chloride by this method was exhibited in action.]

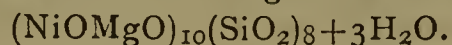
The PRESIDENT thanked the author for having communicated to the Society this elegant method of preparing ethyl chloride, and said that he should be inclined to attribute the peculiar action to the zinc chloride rather than the hydrochloric acid,—the zinc chloride acting on the alcohol, and producing ethyl chloride, water, and zinc oxide, the latter of which was again converted into zinc chloride by the hydrochloric acid—



Mr. GROVES replied that a clear solution of zinc chloride in alcohol of the strength employed in the preparation of ethyl chloride gave off none of the haloid ether whatever when heated alone.

The last paper, a "*Note on a New Mineral from New Caledonia*," by A. LIVERSIDGE, was read by the Secretary. The mineral is found in veins traversing serpentine, and associated with chrome iron ore, steatite, and other minerals commonly occurring in serpentine. It is of a beautiful apple-green colour, and, on immersion in water, flies to pieces with a crackling sound, at the same time becoming translucent. Its hardness is 2.5, and its specific

gravity 2.27. It is a hydrated silicate of nickel and magnesia, to which the author assigns the formula—



The most nearly allied minerals are alipite and pimelite.

The CHAIRMAN having thanked the author for his communication,

Dr. MULLER remarked that the mineral described appeared to be closely related to the "emerald nickel" found in the deposits of chrome iron ore of Texas, in North America, as to its mode of occurrence, &c.: the one, however, being a silicate, whilst the other, the emerald nickel, was a carbonate. He thought considerable caution should be used in assigning formulæ to such substances, as he believed the composition of samples taken from different parts even of the same deposit would be found to vary.

The meeting was finally adjourned until Thursday, May 21, when there will be a lecture on "The Sewage Question from a Chemical Point of View," by Dr. W. H. Corfield.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

April 7th, 1874.

E. W. BINNEY, F.R.S., F.G.S., Vice-President, in the Chair.

Mr. J. Sidebotham and Mr. J. A. Bennion were appointed Auditors of the Treasurer's Accounts.

The CHAIRMAN exhibited to the meeting some portion of the cast-iron roof from the Salford Station of the Lancashire and Yorkshire Railway, which, after having been up for a period of four years, was so much corroded and damaged that it had to be taken down. He attributed the effects to sulphuric acid and soot, arising from the combustion of the coal used in the locomotives passing under it, aided by the action of steam and vibration. He referred to a paper by himself communicated to the Society, and published in vol. ii. (2nd series) of its Memoirs, "On the Effects of Old Coal-Pit Water on Cast-Iron," where similar results had been produced by sulphuric acid, carbonaceous matter, and water; also to a case alluded to by one of the most distinguished members of the Society, the late Dr. W. Henry, F.R.S., of the rotting of cast-iron by the escape of steam from the junction of a pipe embedded in charcoal. Of course the rate of decomposition much depended on the quality of the iron; but as that metal was now so much employed in building and mining operations, he considered it desirable to bring before the public every instance that came to his knowledge where it had been damaged or decomposed.

"On the Action of Nascent Hydrogen on Iron," by WILLIAM H. JOHNSON, B.Sc.

In a paper read before the Society last year, I showed that a piece of iron immersed in hydrochloric, sulphuric, or other acid which evolves hydrogen by its action on the metal, on breaking gives off bubbles of gas from the surface of the fracture. It subsequently occurred to me that these bubbles might be produced by subjecting the metal to the action of nascent hydrogen for some time, and without the aid of acid at all.

To test this, I connected two pieces of iron wire 0.07" diameter respectively with the copper and zinc plates of a battery of 50 Daniell's cells, and immersed them in a vessel of Manchester town's water at a distance of 1 inch apart. On closing the current, bubbles of hydrogen were given off from the wire connected with the zinc, but none from the wire connected with the copper, the oxygen liberated at the pole apparently forming oxide of iron which in twelve hours formed a thick smudge at the bottom of the vessel. After twenty-four hours the surface of the wire connected with the zinc was unchanged, but on moistening the fracture bubbles were given off abundantly, just as if it had been immersed in acid. The other wire, on the con-

trary, though much oxidised and eaten away, did not give off bubbles when broken.

A variety of experiments were made in the same way with pieces of wire varying from 3 to 20 inches long and immersed from five to twenty-four hours, $\frac{1}{2}$ inch to 4 inches apart, in pure Manchester town's water, all with similar results. With this exception, that when the wire connected with the zinc was of steel, no bubbles were visible to the naked eye, just like steel after immersion in acid. Twenty-four hours in a warm room restored the iron to its original state, and no bubbles were seen on fracturing it.

The water in the last experiments was then replaced by an aqueous solution of caustic soda, when, after two hours, the moistened fracture of the wire connected with the zinc pole of the battery was found to bubble. Twenty-two hours' longer immersion, the battery working all the time, caused the bubbles to be more abundant; the toughness of the wire was also diminished, and its surface was blackened. The wire at the positive pole was, however, unchanged either on the surface or in toughness.

Three pieces of wire, each 12 inches long, were immersed in hydrochloric acid about 1.2 sp. gr., one being connected with the positive pole, the other with the negative pole of the battery, and the third unconnected with the battery. At the expiration of half an hour the two last pieces were found to bubble on being fractured, and were also more brittle. The one, however, connected with the positive pole was not in the least affected. Thus showing that simple immersion in acid is not sufficient to produce in iron the remarkable changes before described, unless it be accompanied by evolution of hydrogen.

In conclusion, if the oxidation of the surface of iron be, as a rule accompanied by the absorption of nascent hydrogen into the interior of the iron, then the diminution of strength and toughness consequent on this will affect iron ships, telegraph cables, and other structures in which iron is largely used and which are constantly immersed in water.

"Does the Earth receive any Heat directly from the Sun?" By HENRY H. HOWORTH, Esq.

The term heat is one of unusual ambiguity. It has at least two meanings, which, if they do not exclude one another, are at least not commensurable. Their indefinite and careless use has created great confusion. The first meaning connotes the feeling heat, a purely subjective matter, whose investigation is a proper subject for metaphysical students, but with which we have nothing to do at present. The second meaning connotes objective heat, the force heat, that phenomenon of matter whose effects we can measure in certain definite ways. It is with this second meaning that we are concerned to-night. Having limited our subject somewhat, I wish to limit it further. The science of heat concerns itself with two main subjects, first, the transcendental problems which deal with the nature of heat, which endeavour to explain it as a form of motion, &c., &c. These conclusions may or may not be eventually confirmed by experience. At present they are powerful and ingenious theories which enables us to map out our knowledge, to arrange and classify it, but I humbly crave permission to doubt whether any of them may be considered a final solution, and *pro tanto* I must have my hands free. This is not really of consequence in our discussion to-night, for I have no intention of entering into such a difficult and crooked controversy. The nature of heat is, in fact, outside our present subject. Eschewing the transcendental problems, we shall very briefly consider only the direct effects of heat upon matter. So far, then, as our experience can take us, heat is a peculiar condition or phenomenon of matter, which we can modify, increase, or lessen, which is universally present in greater or lesser intensity, and which we measure relatively by a comparison with a certain fixed standard. However produced, whether by chemical action, by percussion, by friction, &c., &c., there is one result which seems universal, and which may be considered to be the correlative of heat.

This result is universally present, and modified in various ways it is probably the only result; so that, if we exclude the feeling of heat, we may define heat by using this result as an alternative term. The addition and abstraction of heat are correlative respectively with an increase and decrease in the bulk of the matter operated upon. If we add heat, we increase the bulk of the substance operated upon; if we abstract heat, we cause the portion of matter to contract and shrink, and the bulk is increased and diminished in certain definite proportions; and not only so, but the opposite holds good also, viz., that if we cause a portion of matter to shrink, we must in doing so abstract heat from it, while, if we increase its bulk in any way without adding more matter, we must, willingly or unwillingly, add a corresponding portion of heat. I believe this is accepted as an axiom in physics by the best judges, and accepted as universally true. Formerly some substances, such as bismuth, water between certain temperatures, &c., were quoted as exceptions to this rule, inasmuch as they expand in solidifying; but they are only apparent exceptions, for their aberrant behaviour has been shown, as I think beyond doubt, to be a phenomenon of crystallisation. Speaking of the most notorious case, that of water, Tyndall says:—"The arrangement of the atoms of water when solid require more room than they need in the neighbouring liquid state. No doubt this is due to crystalline arrangement. The attracting poles of the molecules are so situated that, when the crystallising comes into play, the molecules unite so as to leave larger interatomic spaces in the mass; we may suppose them to attach themselves by their corners, and in turning corner to corner to cause a recession of the atomic centres. At all events their centres retire from one another when solidification sets in. By cooling, then, this power of retreat, and of consequent enlargement of volume, is conferred."—(Tyndall's "Heat as a Mode of Motion," p. 107). These exceptions, then, I hold to be no exceptions at all. There is one substance, viz., india-rubber, whose behaviour is eccentric and not explainable in this way, nor at present, so far as I know, explainable at all; but with this solitary exception, whose *raison d'être* I have no doubt will be shown to be as consistent with the general law as those of substances such as water, bismuth, &c., we may safely conclude, from our experience of matter, that it is a universal law that heat and expansion, cold and contraction, are correlative terms.

Having laid down an abstract axiom, let us now apply it to a concrete example, viz., the earth.

The old notions about the stability of the earth, when compared with the mobility of the sea, have been long since exploded. We now know that there is no such thing as absolute terra firma. We know that the earth in a less degree is mobile like the water, rising here and sinking there in apparently restless pulsations, waves, swellings, and subsidings. This being so, it becomes an interesting problem to determine whether these risings and sinkings compensate one another; that is, whether a rising in one neighbourhood corresponds to a sinking elsewhere, or whether the whole periphery of the earth is undergoing enlargement or diminution, is stretching or shrinking. To decide this by direct experiment is not easy, for since water is our gauge the same relative effect will be produced either by the sinking of an ocean-bed or the rising of an adjacent continent. But we have a considerable amount of evidence notwithstanding which points, so far as I know, in one direction and one only. There is first the *a priori* evidence.

There are two sciences which deal with the inner constitution of the earth: astronomy, which deals with it as a part of the great macrocosm, the universe; and geology, which deals with its inner life as a universe of its own. The question of the alteration in the earth's bulk has naturally been discussed by both astronomers and geologists, and discussed too from very different points of view, but both are agreed in one conclusion, viz., that the earth is shrinking.

Since the days of La Place, the Nebular hypothesis has been generally received by astronomers as the one which best meets observed facts. This hypothesis predicates the existence of gravitation everywhere, and shows how, by its influence, the various heavenly bodies have become condensed from nebular matter. It predicates that this force is still active everywhere, and that everywhere within our observation we have a condensation of matter in progress, matter condensing from a highly-diffused condition to one of greater density. Thus each member of our system, it is argued, is gradually and surely nearing the sun, and at the same time is shrinking, and the various planets are, in fact, in so many stages of evolution, and exhibit for us the various phases which the earth has passed through and will pass through before it is landed in the sun. And the most ingenious and successful of our analytical astronomers and physicists combined, Sir William Thomson, has compared our universe to an elaborately constructed clock which is inevitably and surely running itself down, until it has exhausted its various forces and until each component member has fallen into the common centre. This is elementary enough. I only quote it to show that the evidence of astronomy is that the earth is contracting, and that its periphery is diminishing in area.

The conclusion of geology for our purpose is the same. It is argued by geologists that the earth was originally in an incandescent state, and that it has assumed its present shape after a gradual cooling, that is, a gradual contraction, which is still in progress. These are the words of Mr. Geikie, one of the most recent and competent authorities:—"Among the geologists of the present day there is a growing conviction that upheaval and subsidence are concomitant phenomena, and that, viewed broadly, they both arise from the effects of the secular cooling and consequent contraction of the mass of the earth." On both grounds, therefore, viz., those upon which astronomical and geological arguments are based, is it established that the earth is shrinking.

As the fire syringe discharges a certain amount of heat when sudden pressure is applied, which heat we can collect and measure, so we ought to be able to measure the amount of heat produced by the contracting of the earth's crust, although we cannot measure that contraction with a plummet. As we go down through the crust we ought to meet with evidence that the pressure of the strata has increased the temperature, and this we in fact do. In going down towards the centre of the earth we find an increase of temperature so wonderfully constant in all latitudes that we are constrained, if we accept the nebular hypothesis, to argue that this results, as it ought theoretically to result, from the pressure of the strata, *i.e.*, from the force of gravity. In some letters that I have recently written to *Nature*, I have tried to show how the areas of upheaval and subsidence on the earth are distributed, my conclusion being that the areas of depression are distributed about the equator, while the areas of upheaval have their foci at the Poles, that the earth is being stricured about the equator, and thrust out in the direction of its shortest axis; in other words, is shrinking in the region where the temperature is the highest, the tropics, and is stretching out in the regions of cold, or the Polar regions.

Now let us see how far we have travelled. We have postulated that all shrinking matter is giving out heat. We have shown that the *a priori* evidence is conclusive that the earth is a shrinking mass. We have also adduced evidence which shows that the earth is in fact hot where it should be hot, and cold where it should be cold, in accordance with the law of contraction; and it seems to me to follow necessarily that the earth is giving out heat,—is in fact a furnace, a heat-producing substance. This seems to be inevitable.

I need not stay to argue that both popularly, and also among scientific men, it is held as a cardinal doctrine that the earth receives a large quantity of its heat directly from the sun, and elaborate calculations have been made to show the terrific quantity of heat so received and the

terrific energy which this represents. We are taught that, of the sun's heat which beats on the earth, one portion is reflected, another is absorbed, and that the latter is what we can alone recognise by our instruments, and whose energy is the subject of calculation. But the absorption of heat means, as we have argued, an increase of bulk, therefore whatever heat the earth absorbs must go to increase the earth's size. It is only on this condition that the earth can absorb heat at all, and it is only by the increase in bulk that we can, in fact, measure or gauge the heat.

But if the earth be shrinking, it is clear that it must give out more heat than it absorbs; it must, in fact, produce enough heat to neutralise the expansion caused by the sun, and some besides, the excess being measured by the amount of contraction that the earth is undergoing. But this means that any heat it receives from the sun is more than neutralised by its own heat; so that, if the sun gave us no heat at all, and the earth continued to contract as it does now, it would not be affected in temperature, save, perhaps, in becoming even hotter; for if we receive heat from the sun which, when absorbed, makes the earth expand, it is clear that a portion of the contracting force of the earth is spent and exhausted in neutralising this expansion, which would be set free in the form of heat if this had not to be neutralised. But I confess that, having brought the argument to this point, I am constrained to go a step further, and to say that if the earth be independent of the sun for its heat, that if independently of the sun altogether it is throwing out an amount of heat equivalent to the amount of its contraction, that it is unnecessary and unphilosophical to postulate the sun as a source of heat, and that we are bound, paradoxical as it may seem, to conclude that the earth does not receive any heat directly from the sun. This conclusion seems inevitable, and if it be, we must face the various difficulties that suggest themselves at every turn, and find a solution to them consistent with it.

I believe these difficulties are not hard to meet. It will be noticed that, in the question I propounded at the head of this paper, I use the word directly or immediately. When I say that the earth is itself the furnace which supplies the phenomena of heat which we study and feel, I do not mean that it does so entirely *per se*, and without any assistance from without. I predicate all through that such heat as the earth possesses is induced in it by the force which is contracting it, by the gravitating force, and this force, so far as our evidence goes, is derived nearly altogether from the sun. My argument is that the heat of the earth is mediately, but not immediately, due to the sun's influence, that the sun's influence causes the earth to contract, and that in contracting heat is squeezed out of it. That we derive no heat whatever *qua heat* from the sun; or, to use a simile, the voltaic battery supplies the electric current which induces the magnetism in the iron, but does not itself furnish the magnetism.

This at once removes a vast quantity of apparent difficulty, for wherever the sun beats there it exercises its influence of gravity, and the result is invariably an induction of heat, so that winter and summer, day and night, are dependent for their varying temperature on the sun, although in a different manner to that popularly supposed.

There is another and a more palpable difficulty that obtrudes itself at once upon one's notice in defending the position I am arguing for. It is said: surely, if we step out of the sunshine into the shade, or *vice versa*, and exclude the radiated heat from the ground, we shall find direct evidence, both from our feeling and from the usual effects of heat, that the sun's rays are distinctly hot, that in beating on our hand, on a moist surface, &c., &c., symptoms of absorption of heat at once present themselves—the hand grows hot, the moisture evaporates, &c. And this is true, in a larger way, of the superficial layer of the ground, which feels the intermittent effects of day and night, summer and winter, by absorbing more or less heat.

How, then, do we account for this? for the heat must be absorbed from somewhere, and the only practicable source is the direct sunshine. My answer to this is very short. If we ascend through the atmosphere we rapidly find the temperature becomes lower; that, as we get nearer the verge of the atmosphere, and therefore nearer the point where there is no atmospheric absorption of the solar rays, we find the temperature to lower so rapidly, that we are justified in concluding that if we could get outside the atmosphere altogether we should find the scorching of the hand, the absorption of moisture, and the various effects we attribute to heat reduced to a minimum, and are justified in concluding that, if the envelope of the atmosphere were removed—if the earth were to be, such as the moon is, without an atmosphere—that its surface temperature would be but slightly affected by the direct sunshine. The effects of the sun's attraction would be distributed throughout the mass of the earth, causing a general contraction and a general relative temperature with its focus at the centre; but there would be no surface layer of an aberrant and peculiar temperature, and few or none of the effects we now find in the direct sunshine. I argue, and I think I am justified in arguing, that these peculiar effects are due entirely to our having an atmosphere, to the fact of there being a medium between the sun and ourselves. If this be so, it is clearly most consistent with our contention, for the sun's contracting force acts not only on the earth's solid matter, but on its gaseous envelope also, and in the latter case with much more powerful results. So that any surface exposed to the sunshine is exposed also to a column of air undergoing contraction or pressure on the part of the sun, and as this compressed air must give out its heat if it is in contact with any body at a less tension, it gives it out to my hand or to the moisture exposed to it, which in the one case feels hot, and in the other experiences an effect of heat, viz., evaporation. It is the column of air that is giving out heat, each ray that pierces it squeezes it and squeezes out of it a certain amount of heat which we attribute directly to the sun's influence, while in fact it is only mediately due to it. This, I think, satisfactorily explains the great and elementary difficulties of my position. I am not aware of any other difficulty which cannot be as easily met, and as I cannot see my way from escaping from the main conclusion at which I have arrived, I have ventured, paradox though it be, to present it for your criticism. To sum up this conclusion in a phrase, I hold that the earth receives no heat directly from the sun, the sun only supplying the contractile force which induces terrestrial heat.

CORRESPONDENCE.

COMMERCIAL ANALYSES.

To the Editor of the Chemical News.

SIR,—I think chemists owe their gratitude to Mr. Stanford for having called attention to some of the most important causes of discrepancy in the statements of the results of commercial analyses. Every analyst who has had experience in particular branches must deplore the want of greater unity among chemists, even in cases in which the truth is within their reach.

I was glad to see that Mr. Stanford mentions the case of the phosphates in the various sewage manures. He seems somewhat surprised that a certain well known agricultural chemist should not have replied to a challenge, three times given, to explain the grounds of an opinion which strikes everyone else as being untenable. Had Mr. Stanford known the chemist in question better, he would scarcely have expected a reply. The same gentleman recently read a paper on milk, which contained some absurd statements and glaring contradictions, some of

which have since been pointed out in the journal in which the paper appeared.

But when the leaders of the profession make incautious statements, the misfortune is that their reputation causes the errors to be mistaken for the truth; and it is practically useless for less known chemists to dispute them, or to point out their inaccuracy, as the politic silence observed is taken by outsiders for "silent contempt," and people say "Professor So-and-so is a very eminent man, and is more likely to be right than Mr. —."

Some time ago I examined an iron ore, the hydrochloric solution of which gave crystals of PbCl_2 when concentrated. Abundance of sulphur was also found, and on careful examination of the bulk fine veins of galena were distinctly visible. The results were reported accordingly, when it appeared that the sample had also been analysed by a London chemist with a large iron ore practice, who had not noticed the presence of lead, and had reported the entire absence of sulphur. A fresh sample was prepared by the importers of the ore. It gave me and a professional friend the same results as before, but the London analyst still denied the presence of more than a trace of sulphur, and though his attention was directed to the presence of lead he reported that there was none present. Fortunately, in this case, the truth came out, for one of the partners of the firm possessed sufficient analytical knowledge to enable him to readily recognise the presence of abundance of lead, though according to the report of the London analyst there was none. That he missed the sulphur was only natural, if he employed the method he has published for the use of others.

The same ore contained 0.1 per cent of P_2O_5 , according to my own analysis. On acquainting this eminent chemist with the fact, he wrote saying that "0.10 per cent of phosphoric acid corresponded to only 0.028 per cent of phosphorus, an amount entirely unworthy of notice." As a matter of fact, 0.1 per cent P_2O_5 corresponds to 0.042 of P, not to 0.028 per cent as stated by the "chemist" in question. Even if the latter number were correct, as practically all the phosphorus goes into the pig, and the ore in question contained 50 per cent of iron at the outside, the iron made would contain 0.056 per cent of P, which, so far from being "entirely unworthy of notice," is nearly the maximum amount allowable in a Bessemer pig, for the manufacture of which the ore was intended.

The result of the discrepancy was not that the analyst in question lost a client, but that the importers concluded that, as sellers, it was better for them to employ a chemist who missed objectionable constituents, and would brazen out his errors, than to have analyses by a chemist whose certificates would have less weight with the buyers, and who called their attention to "profligate associates."

If space permitted I might tell how a certain chemist reported an ore containing much pyrites as "free from sulphuric acid," without mentioning other forms of sulphur, thus obliging his clients and satisfying such conscience as he possessed.

How another chemist reported stuff with 55 per cent of ash as "cannel coal of fair quality;" how a third gave evidence that he "could hold his hand for some minutes in the flame of CS_2 the temperature was so low," and how in subsequent cross examination he was made to admit that iron would melt in the flame.

There is but too much justice in the remark that "scientific men can be got to prove anything," and until chemists regard it as undignified to act as scientific advocates instead of merely giving their unbiassed opinions, there is not much hope of improvement.

But it seems a pity that chemists have not some means of expressing their opinion in cases of gross unprofessional conduct in a similar manner to the lawyers, for if so, there are one or two practitioners I could mention who would stand a fair chance of being "struck off the rolls," and one or two dozen who would never have been on.—I am, &c.,

ACCURACY.

May 2, 1874.

ON THE INDIRECT DETERMINATION OF ALUMINIUM OXIDE IN THE PRESENCE OF FERRIC OXIDE.

To the Editor of the Chemical News.

SIR,—Your last issue contained a note on the above subject by Mr. R. W. Emerson MacIvor. The process he has sketched therein contains no new feature, and is well known. Allow me to direct his attention to a description of it in Church's "Laboratory Guide" (2nd edit., p. 142).—I am, &c.,

C. T. K.

May 9, 1874.

VALUATION OF SALT-CAKE.

To the Editor of the Chemical News.

SIR,—My former letter on this subject having called forth communications from two other correspondents, perhaps you will allow me the opportunity of replying.

Mr. Simmonds recommends a method of determining free HCl in salt-cake which is decidedly objectionable. Admitting the presence of a minute amount of that acid in a free state, the result of igniting the salt-cake, after addition of NH_4HO , will be the formation of NH_4Cl , which reacts on Na_2SO_4 , forming NaCl and $(\text{NH}_4)_2\text{SO}_4$ (volatilised), the loss of weight being due therefore to H_2SO_4 , and not to HCl.

With regard to Mr. Tinniswood's note, it is to be regretted that, at the great centre of our chemical manufactures a method of analysis so evidently imperfect should be adopted. The omission of CaSO_4 in the sum of the impurities cannot be defended on the plea of want of time, for an occasional determination might easily be made, and the average amount of impurities, excluding free acid and NaCl , would then be more correctly found to be 1.5 to 2 per cent, instead of 0.75.—I am, &c.,

WALTER TATE.

Dublin, May 12, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, March 23, 1874.

Operation of Transfusion of Blood, Performed by M. Beheir at the Hotel Dieu.—M. Bouley.—M. Behier insists (among other things) on injection of natural blood without previous defibrination or diminution of temperature, and on performing the injection slowly, and in small quantities at a time.

Plane-Distribution of Pressures in the Interior of Isotropic Bodies in the State of Limited Equilibrium; Mode of Integration of Differential Equations.—M. Boussinesq.

Law of Astronomical Attraction, and the Mass of Various Bodies of the Solar System, and especially on the Mass and Duration of the Sun.—M. Vicaire.—The proportionality of attraction to mass is not a demonstrated truth, and, considered as an hypothesis, it is not verified by its consequences. It is far from being proved that what is called the mass of the sun really measures the quantity of matter it contains. There are reasons for thinking it is not so; and considering the enormous pressure at the centre, there is nothing unreasonable in supposing a mean density equal to ten or perhaps twenty times what is at present supposed (which will multiply the duration by so much). Considering the stellar period

of the sun must have commenced at the end of the geological history of our globe, this should satisfy all the requirements of history and of geology.

Programme of a System of Geography Based on Exclusive Use of Decimal Measures, of an International Meridian O^a , and of Stereographic and Gnomonic Projections.—M. de Chancourtvis.

Note on Magnetism (continued).—M. Gauguain.—In part of this note the author studies some points connected with the constant magnetic state produced in a horse-shoe magnet when the armature has been applied and detached so many times that more detaching does not further weaken the magnetism. It appears that the distribution of magnetism in a direction normal to the surface of the bar is very different in the case of *constant* remanent magnetism and that of remanent magnetism of the first kind. In the former case the density of the magnetism is nearly uniform, whereas in the latter it decreases rapidly out from the surface.

Refraction of Compressed Water.—M. Mascart.—The author followed M. Jamin's method, sending light through two tubes filled with water, and counting the interferential fringes which passed a point of the spectrum when a difference of pressure was produced. A change of pressure of 1 metre mercury caused the displacement of about seventy fringes, and as the tenth of a fringe could be measured, there was much precision in the arrangement. The number of fringes displaced by corresponding variations of pressure is not constant, but increases with the pressure. The author deduces from his experiments the coefficient of compressibility, and the liberation of heat produced by compression of water.

Reply to Critical Observations of M. St.-Claire Deville on a Method for Determination of the Densities of Vapours.—M. Crouillebois.

Atmospheric Dust.—M. Tissandier.—The quantity of solid matter contained in a cubic metre of Paris air (as measured by a method which the author describes) seems to vary between 6 and 23 milligrms. Thus a mass of air, 5 metres thick, over the Champ de Mars will contain 15 kilogrms. of corpuscles. Where they consisted of *débris* of wood, coal, or the like the length reach sometimes 1-10 m.m.; where of mineral matters, silicon, &c., the diameter varied from 1-100 to 1-1000 m.m. The average weight of sediment falling in twelve hours was 0.002 gr. The chemical composition of the dust was—Organic matters, burning brightly, 25 to 34 per cent; mineral matters, 75 to 66 per cent. Iron was found in notable quantity, and the author thinks part of it may come from planetary spaces. Lime, silicon, &c., were also recognised. M. Tissandier further analysed some dust, 1 m.m. thick, on one of the towers of Notre Dame not visited for many years. Its composition well represented that of the aërial corpuscles.

Two New Theorems on Surface of Waves.—M. Mannheim.

Greek Solar Dial found by M. O. Rayet at Heraclen in Latmos.—M. G. Rayet.

Magnetisation of Steel.—M. Bouty.—Hardly suitable for abstraction.

Calorific Effects of Magnetism in an Electro-Magnet with Several Poles.—M. Cazin.—The author enunciates the following simple law. When a straight iron core is magnetised by a series of similar bobbins traversed by a current in directions alternately opposite, and these bobbins determine equal concamerations, the quantities of heat produced in the core by disappearance of the magnetism are inversely proportional to the squares of the numbers of concamerations. The "differential thermo-magnetic apparatus" was a sort of differential air thermometer, the reservoirs of which were formed of iron cylinders (42 c.m. in length, 5 in. diameter, and about 2 m.m. thickness). The curved U-tube, containing water,

showed the difference of pressure produced when one of the reservoirs became heated by magnetism. With a very delicate apparatus M. Cazin has been able to estimate in calories the thermal effect observed, and he hopes to succeed in determining the magnetic equivalent of heat.

Some Endosmotic Properties of the Membrane in the Egg-Shell of Birds.—M. Gayon.—This membrane, detached, permits molecular diffusion only in one direction. Endosmose is energetic from the outer to the inner surface, but almost *nil* the other way. The membrane, further, is readily traversed by the soluble azotised ferment, which has the property of inverting cane-sugar.

Differentiation of Movements in Plants, Provoked or Spontaneous; Study of the Action of some Agents considered Anæsthetic on the Functional Irritability of the Stems of Mahonias.

Thermic Study of the Phenomena of Solution; Reaction of Water with Nitric Acid.—M. Berthelot.—This paper is not adapted for abstraction.

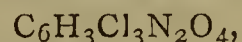
Compounds of Hydrogen with the Alkaline Metals.—MM. L. Troost and P. Hautefeuille.—The authors obtained definite compounds of hydrogen with potassium, K_2H , and with sodium, Na_2H . The former contained 126 volumes of hydrogen, and the latter 237 to 1 of the respective alkaline metals. Lithium, heated to 500° in hydrogen gas under a pressure of 760 millimetres, absorbed 17 volumes of the gas. Thallium, under the same circumstances, absorbed only 3 volumes.

Certain Bronzes from China and Japan.—M. H. Morin.—The composition of these bronzes is shown in the following table:—

	I.	II.	III.	IV.	V.	VI.	VII.
Tin	4'36	2'64	3'27	3'32	5'52	7'27	6'02
Copper	82'72	82'90	81'30	83'09	72'09	72'32	71'46
Lead	9'90	10'46	11'05	11'50	20'31	14'59	16'34
Gold	—	traces	—	—	—	—	—
Iron	0'55	0'64	0'67	0'22	1'73	0'28	0'25
Nickel	—	traces	—	—	—	—	—
Zinc	1'86	2'74	3'27	0'50	0'67	6'00	5'94
Arsenic	traces	0'25	traces	0'25	traces	traces	traces
Sulphur	traces	—	—	traces	traces	—	—
	99'39	99'63	99'56	98'79	100'32	100'46	100'01

Researches on the Formation of Superphosphate of Lime.—M. J. Kolb.

Trichloracetates and their Derivatives.—M. A. Clermont.—The author has obtained trichloracetyl-urea—



by causing anhydrous phosphoric acid to react upon the trichloracetate of urea.

Red Colouring Matter of the Blood.—M. Bechamp.—The author, by a long and somewhat tedious process, has isolated the red colouring matter of blood, in which it is easy to show the presence of iron.

Use of the Bisulphate of Potash for the Distinction of Natural Sulphides.—E. Jannettaz.—This salt may be employed in the state of crystals, or fused at a gentle heat, or in solution. In the two former states, it is ground in a mortar with the sulphides under examination. The following results were obtained:—

A (1). Action of Crystalline Bisulphate of Potash with the Native Monosulphides.—

Galena, PbS	{ Intense escape of sulphuretted hydrogen.
Alabandine, MnS	{ Energetic action.
Blende, ZnS	{ Weaker.
Greenockite, CdS	{ Perceptible.
Millerite, NiS	{ Weak in Bohemian specimens; no action in American.
Chalcosine, argyrose, cinnabar	{ Nothing.

The concrete blende of Raibel acted more energetically than that of Dauphiné.

(2). *Action of the same Salt on Sulphides of the Formula $M_nS_{(n+1)}$.*—

Pyrrhotine, Fe_7S_8 Action slight, but distinct.
Troilite, Fe_7S_8 As above.

In all these cases, acetate-of-lead paper held above the mortar turns brown more or less rapidly—immediately with galena and alabandine, and quickly even with blende and pyrrhotine. There was no disengagement of sulphuretted hydrogen with cubic pyrites, marcassite, chalcopyrite, smaltine, cobaltine, stibine, bismuthine, boulangierite, haidingerite, bournonite, jamesonite, zinkenite. Steinmannite and kobellite (of Hfvena, Sweden) give a strong escape.

B. *Action of the Bisulphate in Solution.*—It acts very energetically upon alabandine; distinctly, though less powerfully, upon galena; less easily upon blende, which requires to be pounded; and not at all upon the remaining native monosulphides. This reaction is valuable for detecting galena in certain compound minerals, for distinguishing alabandine (MnS) from hauerite (MnS_2). Pyrrhotine or magnetic pyrites may be thus detected in mixture with other sulphides.

Moniteur Scientifique, du Dr. Quesneville,
February, 1874.

Preparation of Oxalic Acid from Sawdust, Bran, and Lignose.—W. Thorn.—Oxalic acid is now prepared on the large scale by heating the lyes of potash and soda in certain proportions with sawdust. It has been fully proved that in this process potash cannot be entirely replaced by soda. By the reaction of soda alone upon wood very little oxalic acid is produced, sometimes mere traces. For preparing the mixtures a round iron tank is employed, 5 centimetres high, 10 centimetres in diameter at the bottom, and 13 centimetres at the top. The sawdust is introduced into the boiling lye at 30° to 40° B., and the whole is heated over a naked fire with continual stirring. If the lye is concentrated to 42° B., it is absorbed by the sawdust, and the laborious agitation of the mass is dispensed with. In the course of his experiments the author remarked that there are differences in the yield according to the thickness of the stratum of materials operated upon. In consequence a second series of experiments was carried out, in which the mixture was heated in flat shallow sheet-iron dishes, the depth of the layer being from 1 to 1.5 centimetre. The sawdust employed in the experiments was from pine-wood, and contained 15 per cent of moisture. The action of soda alone upon the sawdust was tried in the proportion of 2 to 4 parts of hydrate of soda to 1 of the wood. The results were—50 grms. sawdust heated with 100 parts of soda in an iron pan gave—At 200° C., 36 per cent of oxalic acid on the wood; at 240° C., 32.2 per cent of oxalic acid on the wood. If heated in thin layers—At 200° C., 34.68 per cent; at 240° C., 31.60 per cent. With 25 parts of wood to 100 of soda—At 240° C., 42.3 per cent. If heated in thin layers—At 240° C., 52.14 per cent. When the heat is above 200° C., the process must be carefully watched, as in case of a sudden rise of temperature the oxalic acid already formed may suffer decomposition. A mixture of potash and soda, according to general experience, gives results equal, if not superior, to those furnished by potash alone. As regards the proportions authorities differ. Fleck states that in the establishment of Roberts, Dale, and Co., Warrington, $1\frac{1}{2}$ parts of hydrate of potash are used to 1 part of hydrate of soda. According to another account 1 equivalent of potash is used to 2 equivalents of soda, which would approximately agree with 1 part of hydrate of potash to $1\frac{1}{2}$ parts of hydrate of soda. In Kuhneheim's works at Berlin the two alkalies are used in equal equivalents. With a mixture of 20 parts potash and 80 parts soda, a peculiar and violent decomposition sets in on every trial, even at a temperature as low as 180° C. Heat was applied from forty-five minutes to an hour.

Ratio of Potash to Soda	Temperature. Degrees C.	Number of Experiments.	Percentage of Oxalic Acid on the Wood used.
20 : 80	190	2	19.78
"	200	1	21.50
"	240	2	30.04
30 : 70	190	3	21.38
"	240	4	38.89
40 : 60	190	1	14.00
"	200	3	30.35
"	240—245	4	43.70
50 : 50	200	2	25.76
"	240—245	4	39.04
60 : 40	200	3	30.57
"	240—245	4	42.67
80 : 20	200—220	4	45.59
"	240	3	61.32
90 : 10	240	2	64.24
100 : 0	240—245	3	65.51

In these experiments, therefore, potash alone proved superior to any mixture of the two alkalies. An essential difference is perceived when the mixture of wood and alkali is heated in thin strata. Sawdust was anew mixed with the boiling lye at 42° B. in the proportion of 50 grms. of the wood to 100 grms. of the alkali. All the lye was absorbed, and the mass was heated on iron plates in a layer of 1 centimetre in thickness. The mixture was frequently stirred, and the heating was continued from one hour to an hour and a half.

Ratio of Potash to Soda.	Temperature. Degrees C.	Number of Experiments.	Percentage of Oxalic Acid.
0 : 100	200—220	2	33.14
10 : 90	230	2	58.36
20 : 80	240—250	4	74.76
30 : 70	240—250	3	76.77
40 : 60	240—250	6	80.57
60 : 40	240—250	6	80.08
80 : 20	245	4	81.24
100 : 00	240—250	6	81.23

If the material is heated in thin layers, and if care be taken to avoid fusion the mixture 40 : 60, or 1 equivalent of potash to 2 of soda, is practically equal to potash alone. Experiments were next tried with currents of warm air directed over the heated mass. The production was not sensibly increased. The addition of manganese was not found useful. A series of special experiments proved that the yield from hard wood was smaller than that from soft species. A relative increase of the proportion of sawdust to the alkali was also tried, but the practical difficulties, both in heating the mass and in the subsequent extraction of the acid, appear serious. When the heating is completed, the mass is boiled with water till almost entirely dissolved, and the mixed decoctions are concentrated to 38° B., when oxalate of soda separates out in fine crystals. To free them from the mother-liquor filter-presses or centrifugals are used. If the fused mass has been properly boiled the mother-liquor may be obtained free from oxalic acid. To transform the oxalate of soda thus obtained into oxalate of lime, it is dissolved in boiling water, and milk of lime is gradually added, so that the lime may be in slight excess. The liquid must be rather dilute or the decomposition is tedious. If a filtered sample, acidified with acetic acid, still gives a precipitate with chloride of calcium a little more milk of lime is needful. When the decomposition is complete, the caustic lye is drawn off, the precipitate is repeatedly boiled with water, and filtered. For the decomposition of the oxalate of lime a large excess of sulphuric acid is required; 3 equivalents of acid to 1 of the oxalate. The oxalate of lime is made up into a very thin paste with water and the necessary quantity of sulphuric acid, let down to 15° to 20° B. is poured in with constant stirring. More water is added, and the whole is gently heated from one to two hours with continual agitation. When the decomposition is complete the liquid is filtered off, and the precipitate of sulphate of lime is washed, being frequently turned over. The filtrate con-

tains oxalic and sulphuric acids, and sulphate of lime. It is concentrated to 15° B., when the sulphate of lime crystallises out. The clear liquid is then drawn off, and concentrated to 30° B. On cooling, the oxalic acid separates out in long crystals, which are further purified by re-crystallisation. The waste alkaline lyes are concentrated to 40° B., mixed with sawdust enough to absorb them, and calcined in thin layers on iron plates, or in a reverberatory furnace till a portion taken out and lixiviated with warm water shows but a very light colour. The dark grey calcined mass is lixiviated with the weak lye obtained when the oxalate of soda is decomposed with lime. The lixivium obtained is causticised with lime, evaporated down to 42° B., and is then ready for re-using.

Soft-Soaps and their Sophistications.—Dr. Vohl.—

Chemistry of Organised Bodies.—M. Ch. Blondeau.—This paper does not admit of useful abstraction.

Metallurgy of Bismuth.—M. Valenciennes.—A large supply of bismuth ore is now brought from Bolivia, where it is found in a vein near mines of silver and copper, at the town of Lucre (Lucra?). The ore consists of sulphuret of bismuth, mixed with iron and copper pyrites. The gangue is quartz. An average sample gave—

Bismuth	22.8
Iron	10.2
Copper	9.5
Sulphur	19.5

(The residue being probably silica.) Antimony, lead, and silver are found in small quantities. The ground ore is roasted for twenty-four hours at a dull red-heat in a reverberatory furnace with a flat sole. A little charcoal-powder is added from time to time, and the mass is frequently stirred with iron rabbles. The ore is next mixed with 3 per cent of charcoal, and a flux composed of lime, sulphate of soda, and fluor-spar. The mixture is heated in a reverberatory furnace with a sole hollowed out like a dish, so that the reduced metal and the slag may be drawn off at a vent-hole in the side of the furnace. At the beginning of the operation the damper is shut so that the reducing flame may facilitate the reaction of the charcoal on the oxide of bismuth, and prevent its volatilisation. The mass is often stirred up for two hours. The damper is then opened, and the fire urged to a white heat. At the end of two more hours the mixture is liquid, and is ready to be run. A mould of cast-iron, lined with clay, is placed under the vent-hole, and the plug is withdrawn. Three distinct layers are found in the mould, separated by their respective densities. At the bottom is a regulus of bismuth, then a matte of sulphides of bismuth and copper, and at the top a vitreous slag containing the iron. The crude bismuth contains 2 per cent of antimony and lead, the same quantity of copper, and traces of silver. The antimony may be removed by fusion with nitre, and the other metals are separated in the wet way.

New Method of Manufacturing Stearine.—Prof. Bock.—The author, or reporter, points out in this paper the errors of the prevailing methods, but the new method is not definitely and numerically described.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 3, March, 1874.

At the meeting of the Society, March 6, M. Clement Sans communicated an improvement on Grüne's encaustic for positives on paper. He takes—

Powdered gum arabic	2 parts.
Powdered sugar-candy	5 "
Transparent glycerine soap, } well grated	10 "

Water enough to dissolve, and then adds—

White wax, shaved	10 "
-------------------------	------

The mixture is placed in an earthen coffee-pot able to contain five times the quantity, and boiled on the sand-

bath with constant stirring. When cold it should have the consistence of good pomade.

Mdlle. Rosine Mezzara traced the yellow spots which spoil so many positives to the ash or the fumes of tobacco. MM. Lacan, Martin, and Peligot confirmed the view expressed in the above communication.

A new process for heliographic engraving is quoted from Figuier's "Année Scientifique." A photographic proof is applied to a sheet of zinc, when the silver, transferred from the paper to the plate, produces a metallic layer which enables the zinc to be attacked by very dilute acids.

M. Rodriguez, of Lisbon, forwarded to the Society a number of proofs in fatty inks obtained by his process.

M. Fleury-Hermagis exhibited very rapid objectives of flint glass, with a base of chemically pure minium. He also presented a large number of specimens illustrating a process which he has invented, and of which he communicated the details.

M. Geymet presented to the Society a volume printed and illustrated by his photo-lithographic process.

M. Pellet exhibited an apparatus for measuring fractions of a second of time, which may be used for determining the time required for exposure, and thus comparing the performance of two lenses. The description of the instrument is not sufficiently clear without the aid of an illustration.

The *Bulletin* contains a continuation of M. De Saint Florent's process of heliochromy, and of M. Th. Sutton's "Theoretical and Practical Studies."

Gazzetta Chimica Italiana, Anno iv., Fascicolo 3, 1874.

Identity of the Cymen of Camphor and the Essence of Turpentine.—E. Paterno.—The author has examined the cymeno-sulphates of lime, baryta, lead, copper, nickel, soda, and potash as obtained from camphor, and the corresponding salts as prepared from turpentine. He considers the identity of the two bodies indisputable.

Peroxide and Acid of Chromium.—Ugo Schiff.—This paper is not well adapted for abstraction.

NOTES AND QUERIES.

Filtering on a Large Scale.—Could you or any of your correspondents give me the best method of filtering silica (finely-divided) and alumina on a large scale?—E. T.

Hydro-Hexa-Glyoxal.—In CHEMICAL NEWS, vol. xxix., p. 207, you notice M. Schiff's hydro-hexa-glyoxal as $C_{12}H_{14}O_8$. I think it is a hexa-glycollic acid, and that the true synthesis would be—



It corresponds with a similar condensation of salicylic acid.—S. E. P.

Coffee and Chicory.—(Reply to A. B. C.)—The formula in question was deduced from the mean densities of coffee and chicory infusions, which, according to the table given, are 1008.6 and 1020.6 respectively. If x be the weight of coffee, and y the weight of chicory, in 1 gram. of a mixture, then $x+y=1$, and $y=1-x$. The density of the solution will depend on the relative proportions of chicory and coffee present, and, if represented by D , then—

$$1008.6x + 1020.6y = D.$$

Substituting $1-x$ for y in this equation, we get—

$$\begin{aligned} 1008.6x + 1020.6 - 1020.6x &= D \\ \therefore 12x &= 1020.6 - D \\ \text{and } x &= \frac{1020.6 - D}{12} \end{aligned}$$

If x is the weight of coffee in 1 gram. of the mixture, then $100x(=C)$ is the percentage of coffee, and

$$C = \frac{(1020.6 - D)100}{12}$$

The chicories I have tested have a higher infusion density than 1020.6, though the coffee infusions give results exactly agreeing with those of the chemists who compiled the table. Possibly the cultivation of chicory has improved, or the roasting is conducted in a different manner. I think the following formula would be preferable:—

$$C = \frac{(1023 - D)100}{14.4}$$

I consider the estimation of chicory by the colour of the decoction gives the nearest approach to the truth.—ALFRED H. ALLEN.

MEETINGS FOR THE WEEK.

MONDAY, 18.—London Institution, 4.

TUESDAY, 19.—Civil Engineers, 8.

— Zoological, 8.30.

— Anthropological Inst., 8.

WEDNESDAY, 20.—Society of Arts, 8.

— Meteorological, 7.

— Pharmaceutical, 11 a.m. Anniversary.

THURSDAY, 21.—Royal, 8.30.

— Royal Society Club, 6.

— Chemical, 8. W. H. Corfield, M.D., "The Sewage Question from a Chemical Point of View."

— Zoological, 4.

FRIDAY, 22.—Royal Institution, 8.

— Quekett Microscopical Club, 8.

TO CORRESPONDENTS.

W. H. Wilson.—Received.

P. H. Davies.—We are not aware that there is.

G. C.—Tollhausen's "Technological Dictionary" can be obtained at Asher's, Bedford Street, Covent Garden.

J. Hopkinson.—You had better advertise for what you require.

R. Irvine.—Only suitable for our advertisement columns.

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CHEMISTRY APPLIED TO THE DETECTION OF ADULTERATION.

By ALFRED H. ALLEN, F.C.S.,

Public Analyst for the Borough of Sheffield; Lecturer on Chemistry at the Sheffield School of Medicine.

(Continued from p. 190.)

II. TEA (*continued*).

Foreign Leaves.—In the recognition of the presence of leaves other than those of the tea-plant, chemistry cannot be expected to play a very active part, though it may sometimes be made of service for obtaining an approximate estimation of the admixture. For this purpose, the percentage of ash, and the proportion the soluble bears to the total ash, are almost the only points on which there are at present sufficient data to be of use.

A specimen of *sloe-leaves* gathered early in September gave, after drying, the following results:—

	Per cent.
Moisture	6.40
Insoluble matter (on whole leaves)	55.90
Tannin (by gelatin)	16.00
Gum	8.90
Ash soluble in water	4.70
Ash insoluble in water	4.04
	8.74

The above analysis shows a composition intermediate between black and green tea, except with respect to the ash, which is considerably higher than that present in tea.

Young *sloe-leaves* contain very little astringent matter.

For the detection of foreign leaves the botanical and microscopical characters are best fitted. Some of the sample to be examined is put into hot water, and when the leaves have unfolded they are spread out on a glass plate and held up to the light, when the venation, serration, &c., are readily observed. The primary venation of the tea-leaf forms a series of well-defined loops, which are not met with in most leaves used as adulterants. The serrations are not mere saw-teeth on the margin of the leaf, but actual hooks. The serration stops short somewhat abruptly at some distance from the base. The Assam tea-leaf is sometimes bi-serrate. At the apex of the tea-leaf there is a distinct notch, instead of a point.

If the under surface of the tea-leaf be examined under the microscope after the separation of the cuticle, the peculiar and characteristic space between the two cells of the stomata is readily perceived. The long unicellular hairs of the tea-leaf are also peculiar. The employment of caustic potash is desirable in observing these characters.

In the *sloe-leaf* the serratures are direct incisions, numerous, often irregular, and extending to the base. There are no spines. The hairs are shorter and coarser than those of the tea-leaf, and are marked in a peculiar manner.

The *elder-leaf* is more pointed than that of the tea plant, and the lobes are unequal at the base. The serratures are direct incisions. The midriff has hairs on it, and on the leaf itself there are several kinds of hairs, notably a short spinous striated hair which occurs on the upper surface.

The serratures of the willow-leaf much resemble those of tea, but the cell-walls of both the upper and under epidermis differ from those of the tea-leaf in not being sinuous, and there are long coarse striated hairs. When perfect, the elongated form of the willow-leaf sufficiently distinguishes it from tea, and the venation is also entirely different.

The chief foreign leaves added by the Chinese are those of *Chloranthus inconspicuus* and of *Camellia sasanqua*, the latter of which presents a close resemblance to the tea-plant.

III. Adulterants Used for Imparting a Fictitious Strength.

These are—Extraneous Tannin Matters, such as catechu; Lie-tea; Soluble Salts of Iron; and possibly Alkaline Carbonates.

Extraneous Tannin Matters, when used in excess, will be indicated by an abnormally high percentage of tannin. The lead process has a decided advantage in this respect, a sample of brown catechu apparently containing 119 per cent of tannin when examined by this method. This anomalous result is, of course, due to the different precipitating power possessed by the acids of catechu, but the consequence in practice would be that a tea containing a very small percentage of catechu in addition to its normal tannin would give a very high result with lead.

In the case of lie and caper teas the astringency is often very high, owing to an admixture of extraneous tannin matters.

Strong infusions of genuine teas, with the exception of some kinds from India, are quite clear, and do not become muddy on cooling. Tea adulterated with catechu gives an infusion which quickly becomes turbid on cooling.

Under the microscope catechu may often be recognised by its structure, and by the presence of acicular crystals.

I have made many attempts to discover a means of detecting catechu in tea by its chemical reactions, and may give the following tests, which are tolerably reliable, but should always be applied to the suspected tea side by side with a genuine specimen:—One gramme of the pure and the same quantity of the suspected tea are infused in 100 c.c. of water, strained away from the leaves, and precipitated while boiling with a slight excess of neutral lead acetate. The filtered solutions exhibit the following characteristic differences. About 20 c.c. of the solution of pure tea, when treated with a few drops of argentic nitrate (avoiding excess) and cautiously heated, gives but a very slight greyish cloudiness, or precipitate of reduced silver; but the same tea containing 2 per cent of catechu (purposely added) gives a copious brownish precipitate, the liquid acquiring a distinctly yellowish tinge.

When the proportion of catechu is somewhat larger, the filtrate from the lead precipitate gives a bright green colour on adding one drop of dilute ferric chloride, while the solution of pure tea gives only a slight reddish colour, due to the presence of acetate. On allowing this liquid to stand, the adulterated tea gives a precipitate of a greyish or olive green colour, the pure tea solution undergoing no change.

These tests, which depend on the properties of catechuic acid, and which answer with caper tea, together with the estimated proportion of astringent matters and the microscopic characters, render the detection of any considerable addition of catechu tolerably certain; but I doubt the possibility of detecting it when present in only small proportion.

Catechu is sometimes added to tea in a separate state, to impart additional "roughness," or to cover the presence of exhausted leaves, but the adulteration is usually made in the form of "lie tea" or of "caper."

Lie Tea consists of the dust of tea- or other leaves mixed with clay, sand, iron ore, &c., and made into irregular masses by means of gum or starch. It is said sometimes to contain even less desirable ingredients, such as "pig's dung," and though such statements must be taken *cum grano salis*, there are one or two facts within my own knowledge which certainly point in that direction. Probably the truth is that the "lie tea" is composed of the general sweepings of the manufactories, and, if so, its nature will vary according to circumstances.

Lie tea when put into hot water disintegrates and falls to powder, in consequence of the solution of the gum or starch used for procuring the adhesion of the other

materials. The iodine-test for starch may be applied to the liquid after acidifying with sulphuric acid and decolorising with permanganate. The ash of lie tea is often as high as 30 or 40 per cent.

Caper Tea is the name given to tea which has been made up into little glossy masses by the aid of gum (or starch). That from the Canton district is invariably adulterated with sandy and magnetic matter, and often with extraneous astringents. It is often largely mixed with foreign leaves. I have never myself met with a caper tea free from one or more of the above adulterants, and I am in possession of a letter from one of the best-known tea-firms in England, stating that "there is not a specimen of genuine caper tea in the world."

The insoluble matter in caper and lie tea is very variable, but usually considerably less than is present in genuine tea. The gum in caper tea often amounts to 15 or 20 per cent. The soluble ash is often less than 2 per cent.

Soluble Iron Salts are sometimes added to tea to give an appearance of strength, by the formation of dark-coloured tannate of iron. They may be detected by shaking the powdered leaves with cold dilute acetic acid, decanting or filtering, and testing the liquid for iron by means of potassium ferrocyanide. By proceeding in this manner, there is no confusion between iron added as a soluble salt (probably as ferrous sulphate) and the ferric phosphate occurring as a natural constituent of the leaf.

Alkaline Carbonates may occasionally be added to tea, as they have the property of increasing the amount of colouring matter extracted on infusion, besides deepening the colour of the solution, even after the leaves are separated. It will be remembered that the addition of a small quantity of sodium carbonate during the re-drying of exhausted leaves prevented their detection by a professed tea-taster, who classed the tea containing 20 per cent of this adulterant as superior to the same tea in a genuine state but somewhat crushed. The presence of sodium carbonate will be at once detected by the persistent yellow flame produced when the soluble ash is heated on platinum wire. The presence of extraneous potassium carbonate would be detected by estimation of the alkalinity of the soluble ash. According to Zöller, the total amount of potash in the ash of genuine tea is 39.22 per cent, and that of soda 0.65 per cent. A number of genuine teas recently examined by Mr. G. W. Wigner showed, on titration of the aqueous solution of the ash with standard acid, an alkalinity (calculated as K_2O) varying from 1.36 to 1.88 per cent of the weight of the tea, the average potash of twenty samples being 1.62 per cent.*

All experiments on the ash of tea concur in showing that it is moderately constant in quantity and composition, not exhibiting the extreme variation noticed in the ash of beech-leaves.†

IV. Facings and Colouring Materials.

It is well known that till recently green tea was almost invariably "faced," the object being to impart a hue demanded by custom, but not naturally possessed by the tea-leaf.‡

Sometimes colouring matters have been used extensively for transforming black tea of low quality into superior green. Except in cases of this kind, where there is a direct fraud on the purchaser by giving the tea a fictitious appearance of value, it seems doubtful how far the facing of tea can be considered an adulteration, as it does not add appreciably to the weight of the article, and few will contend that the facing renders a tea injurious to health.

* Mr. Wigner has also estimated the total and soluble ash in a large number of teas, and his average results are in remarkably close accordance with those given on page 190. Thus the average total ash of twenty-four samples was 5.66 per cent, and the soluble ash 3.01 per cent. The lowest amount of soluble ash found by Mr. Wigner in a tea known to be genuine was 2.75 per cent, and the highest 3.35 per cent. —*Pharm. Journ.*, May 16, 1874.

† *Journ. Chem. Soc.*, 1874, p. 490.

‡ It is a fact well-known to the trade that a certain firm of tea-merchants use some method of removing the facing after the arrival of the coloured tea in this country.

If a portion of the tea is observed under the microscope as an opaque object, the nature of the materials used in the facing may often be recognised at once. When a faced tea is treated with warm water, the colouring matters become detached, and the small portions rising to the surface may be floated on to a glass slide, and at once examined under a microscope, while the bulk of the facing is obtained as a sediment when the strained liquid is allowed to stand. This deposit often has a distinctly greenish colour, from the presence of prussian-blue or indigo. The latter of these is best recognised by the microscope; but the mineral pigment is detected by warming the tea with caustic alkali, filtering, strongly acidifying the filtrate with hydrochloric acid, filtering again if necessary, and testing the clear liquid for ferrocyanide with ferric chloride. On treating the sediment with the alkali it is sure to turn brown, but this must not be taken as a proof of the presence of prussian blue. The residue left after treatment with the caustic alkali should be treated with hydrochloric acid, and the insoluble portion washed, ignited, and fused with alkaline carbonate. In the product, silica is separated by solution in hydrochloric acid, evaporation to dryness, and re-solution in weak acid, the filtrate precipitated by ammonia and ammonium oxalate, and the liquid filtered from this precipitate tested for magnesium by sodium phosphate. Its detection here proves the presence of *steatite* or other *magnesian silicate*, the use of which gives the tea a peculiar smooth appearance and slippery feel.

Arsenite of copper, chrome yellow, and Dutch pink are also said to have been used as facings. Calcium sulphate is often employed.

Turmeric has been detected by some observers, but I have never met with it myself, the yellow colouring matter being generally of a ferruginous nature.

Caper tea is often glazed with graphite.

(To be continued).

ON THE IMPROVEMENT OF THE SPECTROSCOPE.*

By THOMAS GRUBB, F.R.S.

THE importance to which the spectroscope has within a few years reached as an instrument of research renders any improvement therein a matter of general scientific interest. Hitherto it has been under a disadvantage, which, though slight in amount, in those cases where the dispersive power of the instrument is moderate becomes a rather serious annoyance to the observer, when a number of prisms are used in serial combination, and the curvature of the spectral lines is proportionally increased, and only to be restrained in appearance by using a narrow breadth of the spectrum.

I have lately thought of a very simple and practical remedy (which may, indeed, have occurred to others, but which I have not seen mentioned), whereby those lines are rendered palpably straight in a very large field; but, previous to describing it, it is desirable to refer to a statement appearing in the *Astronomical Notices* for March, 1874, viz., that the spectral lines can be rendered perfectly straight, simply by returning them (after their first passage through a series of prisms arranged for minimum deviation) by a direct reflection from a plane mirror; and, further, that this has been accomplished in a spectroscope in construction for the Royal Observatory.

Such a statement has, as might be expected, produced several enquiries; in one case the querist is much interested, viz., by having a very large spectroscope in hands which, from its construction, involves the question of straight or curved lines resulting. It therefore seems desirable to remove any illusion which may be entertained, by a short consideration of the economy of the spectroscope, so far as the question of curvature is concerned.

* A Paper read before the Royal Society.

The curvature of the spectral lines may be considered as function of the dispersion of a prism; it (the curvature) not only always accompanies the dispersion, but further, its character is always the same with respect to the dispersion—that is to say, the centre of curvature will be found invariably to lie in the same direction with respect to the direction of the dispersion, the lines being invariably concave towards that end of the spectrum having the more refrangible rays.* This (which admits of the clearest proof) is adequate to show the impossibility that, by any kind of inversion, whether by reflections or otherwise, we can neutralise the curvature while doubling the dispersion.

If we examine the spectrum as produced by a series of prisms placed in the position of minimum deviation, we necessarily find that the lines of higher refrangibility, also their centres of curvature, lie towards the centre of the polygon, which the prisms themselves affect; and if we arrest the rays at any part of the circuit, and reflect them directly back by a plane mirror, this reflection reverses (right for left) not only the direction of the centre of curvature of the lines, but also the direction of the spectrum itself, both which are consequently doubled in amount after the rays have performed the second or return passage through the prisms; or (conversely) if, after the first passage through the prisms, we reflect the rays so as to pass through a similar set in such manner as to neutralise the curvature of the first set, we shall find the resulting dispersion reduced to zero.

The writer of the article having alluded to a difference between the reflection as given by a plane mirror and a prism of (double) total reflection, it may be observed that, so far as the dispersion and curvature are concerned, the cases are practically identical, the difference being that, in the double reflection, there is a *vertical* inversion of the spectrum, which, however, produces no discernible effect in either the spectrum or curvature of the lines; and as the spectroscopist constructed with the double reflecting prism is known to produce, with double dispersion, double curvature, we here have an additional proof, if such were required, that the single reflecting mirrors does the same.

The remedy, or means of producing straight spectral lines, which I have alluded to is simply that of constructing the "slit" with curved edges instead of rectilinear. There is but little practical difficulty incurred in construction, and no apparent objection to its use. It may be objected that for such variation of prism power in use there should be a special slit. It is, however, only in spectroscopes arranged for high dispersion that the curvature becomes objectionable; in such there is seldom a change required, and a single slit of medium balancing power would probably remove all practical difficulty or objectionable curvature of the lines. I have found by trial that when two compound prisms were in use, giving a dispersion from A to H of nearly 14°, that the spectral lines were straight in a field of 1° when the radius of curvature of the slit was made 1.25 inches.

[NOTE ON THE ABOVE PAPER.]

If a ray of light be represented in any manner through any number of prisms arranged as in a spectroscopist, undergoing, it may be, any number of intermediate reflections at surfaces parallel to the common direction of the edges of the prisms, or more generally if a ray be thus represented or reflected at the surfaces of any number of media bounded by cylindrical surfaces in the most general sense (including, of course, plane as a particular case), the generating lines of which are parallel, and for brevity's

* Professor Stokes has, indeed, investigated a form of compound prism, in which the resulting lines are straight, and in the same principle we may combine prisms (using, of course, media of different optical powers) in which, with a *balance* of dispersion remaining, the curvature might be found reversed; but this does not affect the general law. The curvature in that compound prism, which was the result of various trials, and first used in the spectroscopist of the Great Melbourne Telescope, and now I apprehend in pretty general estimation and use, probably has a less proportional curvature of the lines than the simple prism.

sake will be supposed vertical, and if a be the altitude of the ray in $\sin a'$, a'' , . . . its altitudes in the media of which the refractive indices are μ' , μ'' , . . . then—

(1). The successive altitudes will be determined by the equations—

$$\sin a = \mu' \sin a' = \mu'' \sin a'' = \dots,$$

just as if the ray passed through a set of parallel plates.

(2). The course of the horizontal projection of the ray will be the same as would be that of an actual ray passing through a set of media of refractive indices—

$$\frac{\mu' \cos a'}{\cos a}, \frac{\mu'' \cos a''}{\cos a} \dots \text{ instead of } \mu', \mu'' \dots$$

As $a' < a$, the fictitious index is greater than the actual, and therefore the deviation of the projection is increased by obliquity.

These two propositions, belonging to common optics, place the justice of Mr. Grubb's conclusions in a clear light.—G. G. STOKES, April 30.

ON BUTTERINE.

By J. CAMPBELL BROWN, D.Sc.

A CHEMIST, seeing the word butterine, would be apt to suppose that it is a misprint for butyrin, but it is not so; it is the registered name under which a substitute for butter is introduced into this country from New York. This substance is prepared by the process referred to in CHEMICAL NEWS, vol. xxvi., p. 47; and described in CHEMICAL NEWS, vol. xxvi., p. 106, in *Pharmaceutical Journal*, October, 1872, and in Parkes's "Hygiene," 4th ed., p. 249. Its general appearance, taste, and consistence are very similar to those of ordinary butter; but, notwithstanding that its solidifying-point is lower than that of some butters, it retains much of the peculiar crumbly texture and fracture of dripping.

Examined according to the scheme given in CHEMICAL NEWS, vol. xxviii., p. 1, it gives the following results:—It softens at 78° F., and melts at 86°; when heated and slowly cooled, it obscures the thermometer at 62°, and solidifies at 60°. It contains—

Water	.. ..	11.25 to 8.5
Salt	.. ..	1.03 to 5.5
Curd	.. ..	0.57 to 0.6
Fat	.. ..	87.15 to 85.4
Colouring matter	.. ..	—
		100.00

The fat consists of olein, palmitin, margarin (?), a trace of stearin, and about 5 or 6 per cent of butter. When dissolved in about four times its weight of ether, and allowed to evaporate spontaneously, it does not deposit any fat until more than half of the ether has passed off, and, if the temperature is not below 60°, the deposit is not solid. The first deposit, when dried, fuses at 108°; the second deposit fuses at 88°, and solidifies at 64°.

Under the microscope, butterine does not appear to consist of acicular crystals of fat, but of irregular masses containing a few butter globules, particles of curd, and crystals of salt. With polarised light, the irregular crystalline structure is beautifully seen, and is clearly distinguishable from butter which has been melted and re-congealed. When old and rancid, it acquires the odour and taste of dripping, but it keeps longer undecomposed than butter. When fresh, it is a wholesome substitute for real butter, and, if not brought into the market as butter, no one can reasonably take exception to its sale.

Butterine may be detected by the following characters:—

1. Its crumbly fracture.
2. Its loss of colour when kept melted for a short time at 212°.
3. The behaviour of its ethereal solution.
4. Its action on polarised light.

THE VALUE OF MILK AS AN ARTICLE OF FOOD.

By JOHN HORSLEY, F.C.S.,
Analyst for the County and City of Gloucester.

MILK being one of the necessities of life, its value in respect of the amount of butter and its other constituents becomes of great importance to society, more particularly as entire or pure milk is required for the support of children and invalids.

For a long time methods have been devised for estimating it—such as hydrometers, lactometers, &c.—which are all more or less worthless; and, indeed, the artfulness of some knowing persons has gone so far as even to adapt them to their own advantage, so that those who use them are deceived in their reliability, and the public in consequence have become powerless against such fraud.

Having given the subject many years' consideration, it appears that the only way of meeting it is by resting its value on the amount of cream, or rather butter, it yields when properly treated, discarding all other methods as absolutely fallacious.

There may be two classes of offenders concerned, viz., the milk-producer and the retailer. It has been satisfactorily proved, by me, that fresh milk will throw up the bulk (9-10ths) of its cream in from two to three hours, and very little afterwards; so that if cows be milked, say, at six in the morning, and the milk is not delivered before eight or nine to the retailer, a good part of the cream may have been skimmed off (for there are generally three trials), and even after that it is subjected to further treatment on the part of the retailer, that by the time it is vended little or no cream is left.

I may even go further, and state, as a matter of fact, that afternoon's milk is always the *richest*, and advantage is taken of it by some persons to skim off the cream, and mix the residuary liquor with next morning's milk. Besides serving a useful purpose in the animal economy, the retention of the cream helps to *preserve* the other constituents of the milk from undergoing fermentation, so that its abstraction is a *double* injury, not understood by those who commit it. Cream is worth 2s. 8d. per quart, but the skim only a 1d. or so; the milk trade is therefore evidently in a very unsatisfactory state, and, when water is added, it amounts to a kind of infamy which cannot be too much reprehended, and is deserving of the highest punishment and exposure.

The Method of Testing.—15 c.c., equal to a tablespoonful, or 250 grs., of milk, are first poured into the glass tube, A, which is 11 ins. long, and $\frac{3}{4}$ in. in diameter, and graduated up to 10 ins., each line from 0 to 20 being equal to so much per cent. A similar bulk, $4\frac{1}{2}$ fluid drachms, of methylated ether is next poured in. The tube being taken in the hand, with the thumb *closely pressed* upon it, the contents are briskly agitated for not less than *four or five minutes*, by which operation the milk is broken up and deprived of its fat, or butter. A like measure of methylated spirits of wine is next added, and the whole well shaken up for at least five minutes more, when, on placing it in the stand, B, the oily, or fatty (buttery), matter will *rise to the surface* almost instantly, and can be easily read off, without any heat being used,—every line being equal to 4.15 grs. of solid butter, as proved by experiment.

1000 grs. of milk, yielding 10 per cent of cream, will therefore show eight lines of butter oil (1-5th less in bulk), equal to as follows:—

Two lines butter oil, from 250 grs.
of milk weigh 8. 3 grs.

2
5) 16. 6

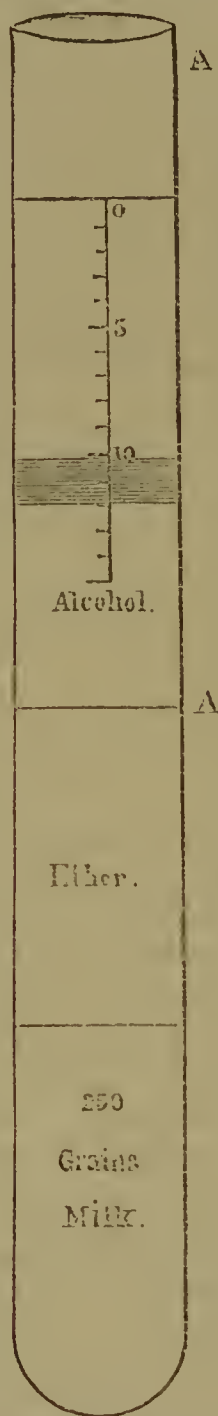
3.32 per cent.

which is the natural quantity from milk of 10 per cent of cream, so that ten lines of cream would represent 33 grs. of butter. In this experiment the milk is separated into

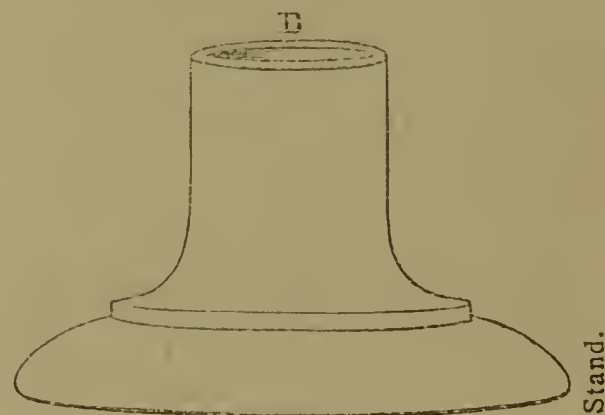
three parts, viz.—the butter which floats on the top, the clear liquor containing the milk salts, and the white flocculent matter (casein) which is precipitated.

If it be desired to analyse it further, the butter oil is to be carefully drawn up into a small Alsopp's minim glass syringe, and the *last* drop of aqueous fluid projected back again, leaving only the butter oil in the syringe, which, by depressing the piston, can be collected in a small weighed platinum or gold capsule, warmed over the water-bath for a minute or two, and the gross weight taken; the tare of the vessel being noted, the actual weight of the solid butter is easily ascertained.

In order to estimate the casein, sugar, and salts, proceed thus:—Fit into a funnel a piece of close cambric, and gently decant the clear liquor of the glass tube, A, add a little distilled water to the casein, agitate the tube well, and project the contents on to the filter, well cleaning it out afterwards with more distilled water, aided by a long feather. When all the liquid has passed through, put it by for evaporation to dryness, for estimation of the milk-sugar and phosphates, if necessary. Then, being provided with a few sheets of stout grey blotting-paper, take out the cambric filter, fold in two, and laying it between the blotting-paper, press out, by hand, all



Graduation of Butter
Oil from a Table-
spoonful of Milk.



Made of Box-Wood or
Tin Loaded with Lead.

moisture. Re-open the cambric, and, placing it on a glass plate, scrape off the casein, dry it in a dish over a water-bath, and take its weight from time to time till it becomes constant.

Having evaporated the clear liquor containing the sugar and salts to perfect dryness over the water-bath, the following would be the result of the analysis:—

Fresh milk density	1.030
Cream	10 per cent
Butter or fat	3.32
Casein or cheesy matter	4.12
Sugar and salts	5.00

12.44 grs. per cent.

plus 87.56 inherent or natural water lost in the process.

Considering this as the *average* composition of genuine milk, any departure from or reduction of this amount of milk solids will indicate the *addition* of so much water, particularly if little or no butter exists, which is the *principal* point in question. Thus; supposing one-fourth or 25 per cent of water had been used, the amount of solids would be reduced 3.11 grs., making them 9.33, which, deducted from 100 of milk, would show 90.67 per cent of water, instead of 87.56 as before stated. On the other hand, if there be *more casein* than the natural quantity, and little or no butter, it would follow that skim had been used instead of water, which would be *equally an adulteration*, as decided by the Glasgow magistrates.

It would be as well to be provided with two of the graduated glass tubes with their stands, one to be used for estimating the amount of cream, by pouring in milk up to 0, and letting it stand for several hours, and another for treating 250 grs. or $4\frac{1}{2}$ fluid drachms measure of milk with, first, methylated ether, and then alcohol as described, so as to estimate the lines of butter-oil from which its weight can be ascertained.

These two experiments (the cream and the butter) may, in most cases, suffice to show the actual value of the milk, the rest, or analytical part, may not be cared for by some persons.

But I would suggest, however, in justice to yourself as well as the milk dealer, the supply of milk should always be obtained *as soon as possible* after the known hours of delivery, if you want it genuine and unskimmed.

Methylated ether and methylated alcohol are cheaper than the purer kinds, and answer quite as well for milk experiments.

By way of recapitulation, if preferred, in the place of using the thumb to cover the mouth of the glass tube during the necessary agitation, a nicely fitting cork will answer as well, using equal quantities of milk and methylated ether first, then holding the tube in the right hand, with your watch in the other, *patiently* agitating it for full five minutes, afterwards pouring in the methylated alcohol up to only figure 10, so as to allow of sufficient room for motion, giving five minutes more for the rest or final operation of agitation, when the butter-oil will rise to the surface on a few minutes repose after placing in the stand.

Sometimes, according to the richness of the milk, as much as four or five lines of clear butter-oil may be obtained. The *whole success*, however (for there is no ambiguity or fallacy about it provided the milk is of good quality), depends on the *amount of agitation* used by the operator, which is analogous to that of churning.

If the film of butter-oil should grow thick from cold the application of the warm hand for a few minutes, or perhaps a piece of spongio-piline wrung out in hot water, to the upper part will render it perfectly bright for drawing off and estimating the actual weight of butter from the table-spoonful of milk used. Then, as two table-spoonfuls are equal to one ounce, multiplying that by twenty, we can tell how much butter a pint of milk will yield.

With regard to the detection of adulteration with water in cases where the evaporation of 250 grs. of milk to dryness, to ascertain the deficiency of solids from the *natural* quantity (12 grs. per cent) is inconvenient, recourse must be had to the use of a small glass spindle, graduated in fives down to 50, by which the density of the skim can be easily taken. Thus, say the cream, having been taken off by means of a separatory vessel, the residuary liquor will show the following variations in density:—

Sp. Gr. of New Milk at 60° F. compared with Water.	Sp. Gr. of Skimmed at 60° F.	Per cent Water used.
1.030 pure	1.031 pure	0
1.027	1.028	10
1.024	1.025	20
1.021	1.022	30
1.018	1.019	40
1.015	1.016	50

ANALYSES OF NATIVE SILVER.

By A. H. CHURCH.

ALTHOUGH innumerable analyses of native silver must have been made, very few have been published in English works of reference. Partly with a view of supplying this deficiency, and partly in order to throw light upon certain archæological questions connected with the arts of alloying and soldering silver, I have lately made several careful analyses of the native metal.

I here publish the results which I have arrived at in the

case of two old specimens of so-called native silver from Allemont in Dauphiné. Both were purchased at Mr. Henland's sale in 1824, and were described as follows:—

"No. 256. Foliated Native Silver on Arseniate of Cobalt. Allemont, Dauphiné."

"No 324. Beautiful Specimen of Ramose Native Silver or Oxide of Cobalt. Allemont, Dauphiné."

The results of the analyses are placed under the headings of the above numbers.

	In 100 parts.	
	No. 256.	No. 324.
Silver	71.69	73.39
Mercury	26.15	18.34
Antimony with trace of arsenic ..	(2.16)	(8.27)
Specific gravity at 16° C.	11.10	10.05

Both 256 and 324 were crystalline in structure, the latter particularly so: both were malleable and flexible. Several silver amalgams occur in nature, but they can scarcely be reckoned as constituting so many species. The first of the above given analyses corresponds pretty nearly to the formula Ag_5Hg , which demands 72.97 per cent of silver, and 27.03 per cent of mercury. The second analysis is not represented accurately by any simple expression, the formula Ag_9HgSb requiring—Ag, 75.11 per cent; Hg, 15.46 per cent, and Sb, 9.43 per cent. Thus it will be seen that the two specimens of so-called native silver of which I have given the analyses above, do not correspond with *arquerite* (containing 86.5 per cent of silver) nor with any of the poorer *amalgams* (those noticed in Dana's "Mineralogy," or Kerl's "Metallurgy") nor with *dysorosite*. But this latter mineral is recorded from Allemont, and so far as its percentage of silver is concerned, does not widely differ from our second mineral, though it is an antimonide of silver without mercury if the published analyses be conclusive.

ON SOME

RECENT PROCESSES FOR THE MANUFACTURE OF SODA.*

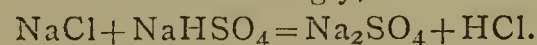
By C. W. VINCENT, F.C.S.

(Continued from page 211).

As already stated, sulphate of soda is formed by the action of sulphuric acid upon common salt, but this does not express the whole reaction. The first product contains much acid sulphate, and part of the salt escapes being acted on. This was probably one of the great rebuffs Le Blanc had to encounter. The reaction is—



In order to completely convert the salt into neutral sulphate, it has to be heated strongly, when—



And the second equivalent of hydrochloric acid is set at liberty.

The apparatus for making salt-cake has been very troublesome to adjust. At first a reverberatory furnace was used for the whole process. Then a division was made, each decomposition being made separately, that in the wet way in a lead-lined pan, the products being afterwards transferred to a brick bed for roasting. Lastly, a concave iron pan was substituted for the leaden one, with great diminution of expense, enabling stronger acid to be used, and preventing the formation of so much bisulphate of soda.

These furnaces are usually set in pairs. The flues pass over and under the salt-cake pans and beds, but not through them.

When a demand arose for bleaching-powder, the hydrochloric acid, which up to that time had been allowed to escape into the air, became valuable, and had to be condensed. The chemist supplied the means with which he

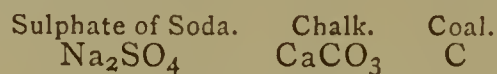
was most conversant, a series of Woulfe's bottles on a large scale. A technologist, however, was at hand, one who was not only a thorough chemist in the fullest sense of the word, but also a mechanic and a physicist. I mean Mr. William Gossage, of Widnes, of whom it may most truly be said, as regards the alkali manufacture—

"Nihil erat quod non tetigit; nihil quod tetigit non ornavit."

Mr. Gossage, with that keen insight which eminently characterises him, saw at once, that which it has taken many subsequent years to impress upon the scientific world at large, that the individual molecules of gases act independently of each other, and that if attacked in mass, only those on the outside are affected. He therefore conducted the hydrochloric acid from the salt cake pots to the base of towers filled with coke, from the top of which a stream of water was allowed to trickle slowly. The gas and water meeting, each in a fine state of division, complete condensation takes place, the independent molecules of water and of gas come into close contact, and in consequence, a stronger acid is obtained than would otherwise be possible on so large a scale of working.

If the towers are of sufficient height, two only are requisite to effect the complete condensation of the acid, but three or more are connected together if necessary.

Having obtained the sulphate of soda, technically known as salt cake, the next and most important process is entered upon—its conversion into carbonate. The sulphate is crushed into small fragments, mixed with its own weight of limestone or chalk, and half its weight in small coal. We have here—



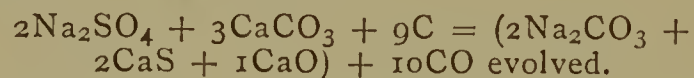
which are fused together. This reaction has been variously represented by chemists. According to Dumas—



The sulphate of lime in contact with incandescent carbon yields its oxygen, and carbonic oxide is evolved, leaving proto-sulphide of calcium in admixture with the carbonate of soda.

Other chemists look upon the reaction as proceeding by two successive stages—the reduction of sulphate of sodium by carbon to sulphide of sodium, which is afterwards carbonated at the expense of the limestone.

In my opinion Mr. Gossage's view, communicated to the British Association in 1861, is most in accordance with the facts, and certainly represents most accurately the resulting compound. His equation is—



The compound substance within the brackets is known as black-ash.

The furnace employed is of the ordinary reverberatory type. The charge is introduced at the end furthest from the fire; when hot throughout it is removed to the fluxing bed, a fresh charge being at the same time introduced. As soon as the mixture becomes soft, and forms clots, it is turned over with an iron oar, until the whole has the consistence of dough. Jets of inflamed sulphuretted hydrogen and carbonic oxide then begin to issue from the mass, a sign that the reaction is complete, upon which the charge is withdrawn from the furnace into iron barrows, each barrowful constituting a "black-ash ball."

Recent researches have abundantly confirmed the old maxim of black-ash men, that the more porous the black-ash, the more easy the extraction of the soda. It is therefore bad working to let the fluxing process go far enough to produce a close heavy black-ash. Black-ash, of course, contains many accidental impurities, but the greater part of the mass consists of carbonate of soda, sulphide of calcium, and lime.

Sulphide of calcium is insoluble in water; lixiviation is therefore easy, but to secure the whole of the alkali is by no means easy, and the services of the technologist have been

exceedingly valuable to the soda maker in this stage of the process. It is essential to dissolve the whole of the alkali, and yet to use as little water as possible, in order to save fuel in after concentration of the liquor. This could not be done by one washing, however long the water remained in contact with the black-ash.

The apparatus at present in use consists of a series of vats with perforated false bottoms, upon which the roughly broken black-ash is laid; a pipe runs upwards from the lower space of the vat which leads into the upper part of the next vat. This is in a like manner fitted with a communication between its false bottom and the upper part of the succeeding vat, and so on. When in regular use, the vats contain black-ash at various stages of lixiviation diffused in their corresponding liquors, one being filled with fresh black-ash, the furthest off in the series containing residuum, all but deprived of its soluble matter. A supply of warm water is run upon the nearly spent vat; this, after permeating the residuum, and becoming impregnated with alkali, rises through the pipe from the false bottom, and flows into the upper part of the second vat, through which it passes, takes up more alkali, and goes to the third, and so into the fourth, where it meets the fresh balls. When the black-ash in the first vat is exhausted, it is shut off from the series, emptied, filled with fresh balls, and becomes the fourth of the series.

The liquor from the black-ash vats is run into tanks and concentrated by the waste heat from the black-ash furnaces; the crystals as they are deposited are fished out, and roasted in a reverberatory furnace, termed the finishing furnace. The product of this furnace is commercial soda-ash, of 52 to 54 per cent. Soda crystals of commerce are formed by the solution and crystallisation of soda-ash. Bicarbonate of soda is made by treating the crystals with carbonic acid.

So well have technologists exercised their skill that for seventy years has Le Blanc's process been worked, and, though attacked on all hands, has nevertheless survived all its opponents, and appears likely to be able to fight its battle against any yet remaining in the field.

I use this phrase advisedly for it is a sober fact that, with the exception of a few processes dealing with materials too expensive for commercial use, none of the so-called new processes but are founded on old and well-known reactions.

Considering the threefold reaction involved in Le Blanc's process, the question, however, arose—Cannot the chlorine in salt be replaced by carbonic acid or oxygen in some more direct way?

The use of litharge and zinc oxide were proposed by Scheele. He found that by triturating either of these substances with salt and water, the salt was decomposed and caustic soda formed. This process fails chemically, so that we do not need to take technology to task for not having done more with it. From time to time modifications of the reaction have been devised, but always with the same result, viz., that 90 per cent of the soda in the common salt remains unconverted.

The mutual decomposition of carbonate of potash and common salt, was at one time made use of for the production of carbonate of soda and chloride of potassium. Here was an interchange of values, and when the potassic chloride fell in price, through abundant and cheaper sources of supply being discovered, the process came to a natural death.

There is one direct process which, however, technology may one day bring to the front, a reaction first discovered by Sheridan, and afterwards improved upon by Swinburne. When steam and common salt are brought together, at a very high temperature, the oxygen of the water combines with the sodium, producing caustic soda, and hydrochloric acid is set free. The process is long, and there is much difficulty experienced from the corrosive action of soda upon the retorts at the high temperature required. This difficulty was to some extent overcome by Powers and Dale, by mixing the salt with scrap iron and passing over it superheated steam whilst heated to redness; but better and

more efficient apparatus is required before this process can compete commercially with Le Blanc's method.

Blanc, Bazille, and Tilghman have endeavoured to overcome the action of soda upon the apparatus by presenting to it at the moment of decomposition a body capable of combining with it. Blanc and Bazille use silica for this purpose. A mixture of salt and sand is heated to redness in an iron cylinder; steam is then passed over it, the temperature being kept up, the hydrochloric acid being conveyed away as fast as it is formed. When the process is complete, neutral silicate of soda remains, which is mixed with two-thirds of its weight of carbonate of soda, and heated to redness in a furnace. The resulting mass is dissolved in hot water. Carbonic acid is next passed into the liquor, when a gelatinous precipitate of silicate acid is thrown down, and carbonate of soda remains in solution.

Another process, the successful working of which depends entirely on the ingenuity and skill with which the plant is constructed, is that patented by Dyer and Hemming as long ago as 1838. When commercial carbonate of ammonia, which is really a mixture of carbonate and bicarbonate, is added in a state of fine powder to a solution of about the same weight of salt in three parts of water, the mixture being well stirred, in a few hours a white crystalline precipitate of bicarbonate is formed, chloride of ammonium remaining in solution. The solid bicarbonate is collected and separated from the mother-liquor by squeezing it in a press, whilst the chloride of ammonium is re-converted into bicarbonate by evaporating it to dryness, and treating as in the ordinary mode of preparing carbonate of ammonia.

The difference in value of soda as carbonate and bicarbonate is very great; the carbonate containing about 52 per cent of soda and the bicarbonate about 38 per cent, are of about the same value.

The chemistry of this process leaves little to be desired. The reaction is perfect and complete, and the whole of the salt is converted into bicarbonate.

The point on which, according to Dr. Hill, the chief interest should centre is, whether the bicarbonate can be obtained sufficiently free from alkaline chlorides to render it capable, by the removal of these hygroscopic substances, to enter the market as bicarbonate.

The grand stumbling-block which, in spite of the many fascinations attaching to this plan of decomposing salt, has hitherto prevented its achieving success, is the great difficulty of avoiding the loss of ammonia during the process, and of recovering it completely from the chloride of ammonium to renew the reaction. This is wholly and solely a question of apparatus. The patents for supposed perfection in the arrangement of modes of working have been very numerous, but as yet none have stood the test of continuous competition with Le Blanc's process. The difficulties should not be insuperable, but require to be viewed from the three points of view of the chemist, the engineer, and the mechanic. Individually each has been unsuccessful, but by combined action they would probably render this mode of carbonating salt one of our great industries.

The latest patent is one taken out by Mr. James Young (so well known for his connection with the manufacture of paraffin). As well for the chemical skill as for the ingenuity displayed with the arrangements for working, this patent has enlisted strong sympathies in its favour.

Of the plans which have been proposed for obtaining soda by the decomposition of salt by oxalic acid, boracic acid, and phosphoric acid, it is unnecessary to speak, the reagents employed being far too costly to sustain the losses they must necessarily undergo in carrying out a manufacture on a large scale.

Sulphate of soda is but very slightly acted on by lime. Dr. Hill, who has recently made many experiments, never succeeded in obtaining more than 1 per cent of the soda in the sulphate, as caustic soda. When heated under steam pressure, the reaction is somewhat more complete. At the Jarrow Chemical Works, with the pressure of 40 lbs. per square inch, about 6 per cent of the soda was causti-

cised, and with a pressure of 200 lbs., maintained for some hours, 13 per cent was obtained as caustic. Manifestly these amounts are far too small to augur any advantages from further research in this direction.

Caustic baryta, on the other hand, decomposes solutions of sulphate of soda of any strength, equivalent for equivalent; so that no concentration of the liquors is necessary, and the sodium is at once obtained as caustic soda; but the sulphate of baryta cannot at present be re-causticised except at so great a cost as to render its use commercially impossible. If, however, any chemist should hereafter arrange a cheap process for preparing caustic baryta, the black-ash furnace and the subsequent troublesome manipulations will speedily become things of the past.

Dr. Hill, in 1865, found that by boiling a mixture of carbonate of baryta with lime, in equivalent proportions, in solution of sulphate of soda under pressure, he obtained a complete decomposition, getting all the soda as caustic without a trace of sulphate, whereas if carbonate of baryta alone is used, as proposed Köbunter, only 75 per cent of the sulphate is causticised. But, as he remarks, though this process does away with the difficulty of obtaining caustic baryta, it is questionable whether the recovery of the carbonate of baryta from the mixture of sulphate of baryta and carbonate of lime, would be any cheaper than attempting to recover baryta in the caustic state from the sulphate.

(To be continued.)

NOTICES OF BOOKS.

Six Short Lectures on Experimental Chemistry. By J. EMERSON REYNOLDS, F.C.S. Dublin: Hodges, Foster and Co.

IN these lectures the author departs widely from the usual routine of elementary treatises. Instead of beginning with a detailed examination of the elementary bodies, he takes up a few substances—two only in the outset—and by their aid explains chemical action in its two great phases of combination and decomposition. The balance is appealed to almost from the first, and the student is led, by a quantitative examination of his experimental results, to the fundamental truths of constant composition and of combination in definite proportions. We believe that the author is right in the general plan he has adopted, and that instruction of this nature would greatly facilitate the acquisition of clear and distinct ideas of the leading facts and laws of chemistry.

A Manual of the Chemistry of the Carbon Compounds, or Organic Chemistry. By C. SCHORLEMMER, F.R.S. London: Macmillan and Co.

DR. SCHORLEMMER is doubtless well known to many of our readers, both as a successful teacher of chemistry and as a meritorious investigator. The present work is, in its arrangement, based upon the lectures on organic chemistry which for the last few years the author has delivered at Owens College, Manchester. Of course, no single volume could contain a description of all the carbon, or, as they were formerly called, organic, compounds. Those only, therefore, are here described which have either a theoretical interest, or which are medicinally or industrially important.

After a brief introduction, in which the author refers to the erroneous assumption, now abandoned, that there existed an essential difference between organic and inorganic bodies, we find an account of the chemical nature of carbon and of the constitution of its compounds. Next follows a brief, but clear, description of the ultimate analysis of carbon compounds, illustrated with the necessary engravings. Curiously enough, in the determination of nitrogen by Will and Varrentrapp's method.

the old charcoal combustion-furnace is figured. Instructions are also given for the determination of vapour densities. Sections follow on the determination of the molecular formula; on empirical, rational, and constitutional formulæ; on isomerism; on the physical properties of the carbon compounds, with some useful remarks on fractional distillation.

The author then proceeds to a systematic description of the carbon compounds, arranged under the following groups:—Oxides and sulphides of carbon with the cyanogen compounds; the fatty substances, and the compounds nearly connected with them; the compounds richer in carbon than the fats; and, lastly, a number of animal and vegetable compounds whose relations to other bodies are not determined.

The work may safely be pronounced a useful addition to what may be called the educational department of our chemical literature.

Will a Sewage Farm Pay? By Lieutenant-Colonel A. S. JONES, V.C. London: Longmans, Green, and Co.

Is there any causal connection between the possession of the Victoria Cross and a propensity for sewage irrigation? Does the love for encountering dangers which enables its possessors to earn so honourable a distinction in war urge them, in time of peace, to attempt the solution of one of the most difficult problems of the day? Or are our gallant soldiers carried away by their experience of normal irrigation in India? If so, we fear that they overlook certain important distinctions between the two cases.

The irrigation farmer or planter in India allows the water to flow upon his land when, and only when, the state of the weather and the condition of his crops make it requisite. The sewage-irrigation farmer in England has no such privilege. In seed-time or harvest, in summer or winter, the sewage flows from the town, and must, by contract, be admitted upon the land. If excluded from one field, as being unnecessary or hurtful, it must flow over others. Again, the climate of India is characterised by long periods of drought, and though its total average of rainfall is copious, its amount of evaporation is very great. Hence, irrigation is there of the highest value. At home these conditions are very different. Our evaporation is comparatively trifling; our rainfall is, in ordinary seasons, so distributed, that injury to crops from lack of moisture is rare. If we look to the two crops on which the food of the English people mainly depends—wheat and potatoes—we may say that, for one season when these are injured by deficiency of moisture, there are twenty seasons where they are damaged by its excess. We fail, therefore, to see that there is in England any great sphere for irrigation. Cabbages and rye-grass, when produced on the small scale, may find a market. But if London, Liverpool, Manchester, Leeds, and Birmingham decide on adopting the irrigation system, these kinds of produce would not easily find purchasers.

There is another point which we must not overlook. Since February, 1872, when Colonel Jones commenced his experiments in sewage-farming, we have had no severe and prolonged frosts. This, unless the climate of England has lately changed, is a fortuitous circumstance upon which it is impossible to reckon in perpetuity. Leaving out of consideration those rare seasons when the thermometer has remained below 32° F. for twelve or thirteen consecutive weeks, we must remember that severe frosts of a fortnight's duration are nothing uncommon. At such times irrigation must completely break down. The sewage, unable to soak into the frozen earth, must spread over the surface, finding its way into rivers, flooding public roads, and occasioning serious inconvenience to the public.

The author expresses the opinion that there are "few more healthy residences than a well-managed sewage farm." Perhaps, when his experience has become greater, his views on this subject may be modified. Official docu-

ments, quoted in the CHEMICAL NEWS, recently brought to light the fact that in India irrigation exercises an unfavourable influence upon the health of the locality, and that a committee appointed to take this matter into consideration recommended that belts of trees should be planted between irrigation lands and the adjacent villages. If mischief thus arises from occasional irrigation with clean water, surely constant irrigation with sewage cannot be less dangerous. We have never maintained that sewage-farming must, under all circumstances, prove a commercial failure. The brief experience of Colonel Jones is as far from demonstrating that irrigation is the best mode of dealing with sewage as the proverbial "one swallow" is from making a summer.

The Constants of Nature. Part I.—Specific Gravities; Boiling- and Melting-Points, and Chemical Formulæ. Washington: Published by the Smithsonian Institution.

THIS work gives, in parallel columns, the names of the bodies, elementary or compound, their formulæ, specific gravities, boiling- and melting-points. At the foot of each page are given the authorities. There is a list of the principal papers used in compiling the tables, an explanation of abbreviations, an appendix giving determinations made subsequent to the completion of the body of the work, and an index of substances.

These tables will prove very useful to chemists and physicists.

CORRESPONDENCE.

COMMERCIAL ANALYSES.

To the Editor of the Chemical News.

SIR,—It is now three years ago that I endeavoured, through the medium of your valuable paper, to obtain from Dr. Voelcker an expression of opinion as to the comparative values of the phosphates of alumina and lime as fertilisers. Feeling interested in manures, my attention was naturally drawn to the very favourable report generally which Dr. Voelcker wrote on Price and Forbes's patent process for the utilisation of sewage, and to the analysis of the sewage precipitate obtained by the phosphate sewage company, as well as to the high money value which Dr. Voelcker assigned to the manure. My letters remained, however, unanswered, and I should not have encroached further upon your valuable space had it not been for an article on "Commercial Analyses," by Mr. Stanford, which appeared in the CHEMICAL NEWS, vol. xxix., p. 190, in which the author revives the subject, and remarks that "either Dr. Voelcker has made a mistake and will not admit it, or else phosphate of alumina has a manurial value which has not hitherto been assigned to it; and, if this be the case, why is it a drug in the market?" My opinion on the subject is that which I expressed three years ago, and subsequent events have proved that I was justified in asking Dr. Voelcker whether he had not overestimated the worth of the precipitate in question. Either the phosphates of alumina and iron are of value as a manure, or they are not: if they are, why then are they drugs in the market? if they are not, Dr. Voelcker must admit he made a mistake in valuing at £7 7s. per ton a manure which contained all its phosphoric acid fixed with those bases.

As no reply has been vouchsafed by Dr. Voelcker, I am sure your readers will agree with Mr. Stanford that it is to be "regretted" that Dr. Voelcker should persist in refusing to retract an erroneous opinion, or should decline to show that the substance in question has the money-value he assigned to it, and in what sense he considers it "equivalent to 62 per cent of tribasic phosphate of lime."—I am, &c.,

SUPERPHOSPHATE.

London, May 12, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, March 30, 1874.

Apparatus Designed by M. Moncoq for Transfusion of Blood.—M. Bouley.—It consists essentially of a glass pump, the piston of which is moved by a toothed wheel turned alternately (a quarter of a turn) in opposite directions. The return of blood by the orifice of entrance is prevented by valves. To the side of the lower part is connected a glass funnel for receiving the blood as it comes from the vein, and which the pump immediately sends into a tube communicating with the vein of the person operated on. In another modification a small cupule is applied, inverted like a cupping-glass, to the vein from which the blood is to be taken (after lancing), and the blood flowing out is immediately forced by the pump into the vein of the other person.

Integration of Equations with Partial Derivatives of the Second Order.—M. Pesait.

Artificial Production of the Phenomena of Gaseous Thermo-Diffusion of Leaves by Moist, Porous, and Pulverulent Bodies.—M. Merget.—The author first mentions some experiments as showing the influence of humidity in thermo-diffusion in a leaf of *Nelumbium*. Such a leaf, fresh, with cut petiole immersed in water, may retain its thermo-diffusive power entire days, gradually losing it, however, as it dies. By moistening again the power is restored. The thermo-diffusive process is enunciated as follows:—In a moistened porous diaphragm, whose two faces are subject to unequal evaporatory movements, this inequality causes diffusion in one and the same gas originally in the same state on both sides. The gaseous current then arising proceeds from the face which evaporates more to that which evaporates less. M. Merget constructs "thermo-diffusers" for showing this. They consist of a plate-shaped vessel of porous baked clay, and containing pieces of the same clay, the varnished neck having an abductor tube fitted to it. Moisten the surface with ordinary water, and put the end of the tube in water, then gradually heat the vessel in a stove. At pretty low temperatures (30°) it begins to give passage to the exterior air, and the diffusive movement progresses with the temperature. Thus introduced under pressure, the air passing through the vessel is liberated in bubbles from the abductor-tube. This liberation is not the effect of expansion and condensation of the interior vapour; for it occurs, and may even be accelerated, when the thermo-diffuser is filled with quicklime, or when it is heated to a temperature under 100°, and the abductor-tube placed in boiling water. The results are independent of the nature of the porous body employed and of the moistening liquid, provided this is volatile. Pulverulent substances also show thermo-diffusive properties when moistened and sufficiently condensed by sinking. An arrangement for illustrating this is described. Thus the ground, in certain conditions, is favourable to the phenomenon. When moist and strongly heated by solar radiation its surface gives access to the external air, which penetrates from the hotter to the colder layers.

Method of Photographic Enlargement for Astronomical Observations.—M. Zenger.—To obtain an image of the sun he replaces the lenses by a mirror with long focus, giving images 25 to 50 m.m. diameter. The insignificant spherical aberration can be corrected by a new method applicable to all photographic processes. It was suggested to him by looking at Rutherford's photographs with a Galilean telescope, which showed minute craters that were not visible to the naked eye, nor with aid

of a lens. He concluded the aberration was corrected through the combination of positive with negative lenses. Suppose we have photographed the sun or the moon with an astronomical telescope, in which the remaining aberration is $+\lambda$, and that we use another optic system with total aberration $-\lambda^1$, lastly that the enlargement produced by this system is m , then the remainder of aberration of the image will be $L = \lambda - m^2\lambda^1$. Hence we may get images with an aberration of $\lambda = m^2\lambda^1$, or with a negative aberration $m^2\lambda > \lambda^1$. We may, then, photograph this image with a negative aberration, using a concave mirror or an aplanetic lens, giving the same aberration $L = \lambda - m^2\lambda^1$, but positive. With this method of successive enlargements of photographic images of the moon and sun the author obtained images 110 inches in breadth. This for the moon is a magnification 2400 times. All details come out very distinctly. The author proposes his method should be employed in the approaching transit measurements. He would observe the passage of Venus by a given point of the sun's disc, instead of contact with the border. He considers that the transits of Mercury, which occur more frequently, might also be taken advantage of.

Electric Automatic Whistle for Locomotives.—MM. Lartigue and Forest.—The lever of the whistle is wrought by an electro-magnet. On passage of a current in a certain direction the magnet lets go the lever, and the whistle sounds. The apparatus is connected by insulating wires with a metallic brush projecting below the locomotive. At a short distance in front of the sight signal there is a metallic plate between the rails, which, when the signal is turned in the position for stoppage, is connected with a source of electricity. On passage of the brush over the plate the current flows and the whistle sounds. It continues to do so till adjusted again by the engine-driver. The Chemin de fer du Nord have used the system eight months, and with satisfactory results.

Use of Luminous Signals in Geodetic Operations.—M. Laussedat.—Suppose a telescope directed, in a station at which we are, to another to which we wish to send light. Place at the focus a diaphragm with very small aperture, such that the field of vision only includes the building (tower or the like) in which the other observer is. Remove the eye-glass, and put behind the diaphragm in the axis of the telescope, first, a convergent glass, then a luminous source, the conjugate image of which produced by the glass falls exactly in the opening of the diaphragm. The luminous bundle will then fall on the building included in the field of vision, and the light will be invisible to any that are out of this field. The distant observer will perceive this bundle in full. He will see the object-glass of the emitting telescope illuminated throughout its surface, and the greater the diameter of this the further will the signals be perceptible. A simple petroleum lamp will give signals visible to the naked eye at 36 kilometres.

The Analysis of a Closed Condenser proves that the Electric Induction does not Traverse the Conducting Masses.—M. Volpicelli.

Movement of Air in Pipes.—M. Bontemps.—When a pipe is transmitting air, and one point of it is heated, then on either side of this point the modification in the pressure is inverse; before the point the pressure increases, behind it falls. Hence if two points are equally heated the pressure in the middle of the interval is not altered. M. Bontemps points out the analogy of the experiment he describes with that of introducing an electromotive force into a galvanic circuit. The consequent modification in distribution of electric tensions, according to Ohm's law, is of the same nature as the change of pressures in the current of air. He proposes to show that the analogy is more profound, and that the methods of measuring the electric current apply to determination of the intensity (quantity and weight per second) of an air current.

Experimental Researches as to the Influence of Changes in Barometric Pressures on Phenomena of Life. (Thirteenth note.)—M. Bert.—The author describes

experiments on man. He went into his decompression apparatus, and caused the pressure to be reduced to 450 m. in about half-an-hour; it was kept between this and 408 m.m. (corresponding to heights of 4100 and 5100 m.) for an hour and ten minutes; then the normal pressure was gradually restored. At 450 m.m. he experienced mountain sickness; felt heavy, weak, and sick; with fatigue of sight and general indifference. On raising the right leg it was seized with convulsive tremblings, which extended to the left leg, and continued some minutes. The face was congested, &c., he was unable to whistle. But the interesting point in the experiment was this:—He had taken in with him a small vessel of pure oxygen. When the pressure was 450 m.m., and the pulse had risen from 62 to 84, he made an inspiration of oxygen; immediately the pulse fell to 71. It rose again to 100 on his making an effort with the spirometer, but a fresh inspiration of oxygen brought it to 70. A like result followed other inspirations. Through inhaling the oxygen the mountain sickness disappeared. These facts have lately been utilised by MM. Croce-Spinelli and Sivel in a balloon ascent.

Action of Ammonia upon Aceton.—W. Oechsner and A. Pabst.—The authors conclude that in the action of ammonia upon aceton there is formed not a trace of aldehyde or of methylamin, and that the product of the reaction of these two bodies is the acetonin of Stædeler.

On Egyptian Blue.—H. de Fontenay.—The specimens examined gave on analysis—

Silica	..	..	..	..	70.25
Oxide of copper	..	..	..	16.44	
Iron and alumina	..	..	2.36		
Lime	..	..	..	8.35	
Soda	..	..	..	2.83	
					100.23

without a trace of cobalt. By mixing—

White sand	..	..	..	70
Black oxide of copper	..	..	15	
Chalk	..	..	..	25
Carbonate of soda, dry	..	..	6	

the author obtained, after due ignition, a blue frit quite analogous to the azure of the ancients. It is necessary to raise the temperature gradually to 1000°, and to maintain it at that point for some time without allowing it to rise higher. If the heat becomes excessive the colour changes to a dirty green, and then to brown.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 12, March 19, 1874.

In a paragraph, the authority for which is not given, mention is made of explosive diamonds in South Africa. The explosion generally takes place during the first week of its exposure to the air, but cases have occurred of explosion three months afterwards. By coating the diamonds with tallow these accidents may be prevented, but a diamond which can only be preserved in this manner is evidently valueless.

Megass, the residual matter of the sugar-cane after extraction of its juices, is found to be an excellent material for the paper-maker.

No. 13, March 26.

New Manure.—MM. Béllinet and Martinet state that they have succeeded in converting the nitrogen of the air into ammonia without expense, without chemical manipulation, and even without human intervention at all, by the use of certain bituminous schists. These schists contain all the elements necessary for the growth of plants in much larger proportions than farm-yard manure. Sulphide of carbon is produced at the same time, and is said to be the only remedy for the Phylloxera.

No. 15, April 9.

Gilding on Zinc.—C. D. Braun dissolves sulphide of gold in sulphide of ammonium, deposits a layer of gold upon pieces of clean zinc plunged into it, the air being excluded as far as possible.

Aluminium Silver.—The following alloy is distinguished by its beautiful colour, and takes a high polish:—

Copper	..	..	..	..	70
Nickel..	..	..	..	..	23
Aluminium..	..	..	..	..	7
					100

Use of Potash as a Manure.—Boutard and Dejoux recommend potash to destroy the Phylloxera, and suggest at the same time that the soil of the vineyards must be exhausted of this alkali.

Nos. 16 and 17, April 16 and 23.

These numbers contain no original chemical matter.

Reimann's Farber Zeitung, No. 7, 1874.

This number contains articles on the production of "Paris black" upon silk; on grinding indigo; receipts for a fast Nicholson blue on wool; for a royal blue on woollen cloth; on dyeing wool with indulin and bengalin; on chrome-orange upon cotton.

Oil Mordants for Cotton-Dyeing.—Mix 6 lbs. of olive oil with 8 lbs. of alcohol, and add 8 lbs. of boiling water, with constant stirring. Add finally $\frac{3}{4}$ lb. of oil of vitriol, previously diluted with water (? how much), and stir well.

Next follow a receipt for finishing cottons; for printing aniline green upon calico; for stripping Schweinfurt green and Nicholson blue from worn tarlatanes; for a brown on woollen garments; and for dressing silks.

A. W. Hofmann has found among the distillation-products of beech-tar which pass over last, a colourless oil, which boils at 270° C. It congeals with the fixed alkalies and with ammonia to crystalline salts, and, in contact with bichromate of potash, turns rapidly brown, and after a few moments forms a felted mass of violet crystals. The latter dissolve in sulphuric acid with a corn-flower blue, and display all the properties of coerulein. The oil may also be oxidised to a substance which forms large yellow crystalline needles, and dissolves in sulphuric acid with a crimson colour.

No. 8, 1874.

This number contains receipts for a variety of colours on wool, woollen yarn, and shoddy; for a cheap black on old silk; for printing a black and white design on a madder-red ground; and for a light brown and a fast madder-red on cotton.

No. 9, 1874.

This number contains a notice of the new Industrial Society of Rouen, which has just published its first *Bulletin*, containing an interesting article on calico-printing.

There are receipts for topping vat- and alkali-blues on wool with aniline violet; for a green upon wool with Nicholson's blue, and for the same shade upon woollen goods with cotton warp; for printing deep violet upon cotton yarn (warps); for a vat-blue upon cotton-yarn topped with logwood-blue; for a madder-rose on cotton and linen; for heavy browns on silk; a continuation of the article on dyeing and finishing plush; and a dressing for coarse linen.

Saffron Substitute.—This is a new trade-name for the binitro-cresylate of potash, otherwise known as Jaune d'Or. It agrees in its chemical constitution with Victoria orange, but the properties of the two bodies are not identical.

Dyeing with Mahogany Sawdust.—A Mr. C. Dreyfuss, a correspondent of the *Farber Zeitung* residing in England, has patented mahogany sawdust as a ware for dyeing and printing browns on cotton. He mordants with tin, and uses a little lime and glue in the dye-beck.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of bichromate of potash, or salts of similar commercial properties. Alexander Gow, Ladbroke Grove Road, Kensington, Middlesex. July 18, 1873.—No. 2472. 1st. Using ground carbonate of lime (unburnt) instead of quick-lime. 2nd. Using a compound salt formed of carbonate of potash with carbonate of soda. 3rd. Using a compound salt formed of sulphate of potash with sulphate of soda and carbonate of barytes, or using a compound salt formed of sulphate of potash with carbonate of barytes.

Improvements in the production of citric acid, tartaric acid, and alcohol. Antonio de Saldanha Albuquerque e Castro, Condi de Penamacor, Antonio Paes de Sande e Castro, both of Lisbon, Portugal, and Thomas Smith Hopcraft, Mincing Lane, London. July 19, 1873.—No. 2484. This consists in the use of the "tamarinha" plant, which is cut, preferably when in a green state, and is subjected to pressure to extract the juice therefrom, which is afterwards operated upon by the usual appliances or machinery by which citric acid, tartaric acid, and alcohol are generally made.

Improvements in the manufacture of steel. John Henry Johnson, Lincoln's Inn Fields, Middlesex. (A communication from Victor Honoré Eugene Gallet, Paris). July 19, 1873.—No. 2487. This invention relates to a peculiar process and composition for obtaining cast-steel or steel of cementation of the best quality from ordinary iron, iron puddled with coke or with wood, puddled steel, Bessemer steel, cuttings of old steel springs, and in general all steels obtained directly either from the ore or from cast-iron. To obtain cast-steel of the best quality from the class of iron above mentioned, it is proposed in general to employ a cement or composition composed of the following ingredients in about the proportions given:—

Alumina	0.50 to 1 part by weight.
Clay of a highly aluminous character	12 to 20 "
Powdered wood-charcoal, soot, and lamp-black	50 "
Carbonate of lime	38 to 42 "
Carbonate of potash	18 to 30 "
Carbonate of soda	2 "
Caustic potash	0.50 to 1 "
Oxide of manganese	4 "
Resin	4 to 5 "
Common salt	1 "
Sal-ammoniac	0.50 to 1 "
Borax	0.50 to 1 "
Water	About 10 per cent of the weight.

An improved cement for joining leather, wood, china, glass, and other articles. Francis Harrison, Stockport, Chester. July 19, 1873.—No. 2488. I first take 1 lb. of acetic acid, and dissolve therein, in a jar or other vessel, $\frac{1}{2}$ lb. of gelatin, $\frac{1}{2}$ lb. of fish-glue, and 1 oz. of isinglass. The acid will dissolve the other ingredients cold, but the application of heat hastens the process. This I call solution No. 1. I then take $\frac{1}{2}$ oz. of resin, and place it in a corked bottle with 2 ozs. of spirits of turpentine till dissolved; or I take the same quantity of gum mastic, and dissolve it in spirits of wine; but this is more expensive, so I prefer the former, which I call solution No. 2. When thoroughly dissolved I take these two solutions, and mix and stir them well together. For shoemaking purposes, I sometimes add a third solution (No. 3), composed as follows:— $\frac{1}{2}$ lb. of gutta-percha, dissolved in $\frac{1}{2}$ lb. of sulphate of carbon. This is to be put in a bottle tightly corked, and, when it is dissolved, add to it 2 ozs. of the cement above named, composed of solutions No. 1 and No. 2 mixed together.

Improvements in the treatment of sewage and cesspool water. William White, Thurlow Road, Hampstead, Middlesex. July 24, 1873.—No. 2532. This Provisional Specification describes treating the sewage, &c., with chloride of calcium, and sometimes with sulphate of iron and lime.

Improvements in treating sewage and other foul liquids for the economical removal and utilisation of soluble and suspended impurities contained therein, and in apparatus for the same. James Robey, sugar refiner, Manchester. July 25, 1873.—No. 2534. The object of this invention is to treat sewage and other foul waters for the purpose of purifying the same by a combined system of precipitation and filtration. I take raw peat, and well macerate with water to a fluid consistency, and mix the same in the proportions stated with the sewage or other foul liquid. Perchloride of iron or other flocculating or coagulating agent is then added, and the whole run into a tank fitted as described, with upright filtering frames of any convenient shape, made by preference of bamboo or cane, and covered with any suitable filtering material, whereby an enormous area of filtering surface is obtained in proportion to the area of ground covered by the tank. The clear effluent water I then pass through beds of any suitable charcoal to remove the soluble impurities, by preference using that made from street sweepings, and described in the specification for which Letters Patent were granted to the present applicant and George Frederick Chantrell, No. 957, 1873.

Improvements in treating cotton waste, hair, wool, and oleaginous seeds for the removal of oil or grease; also applicable for the same purpose to hides and skins, and in preparing the same for tanning, and for preventing mildew in cotton and other fabrics, and in apparatus for such purposes. Arthur Granville, tanner, and Edwin Eli Johnson, pharmaceutical chemist, both of Manchester. July 25, 1873.—No. 2540. The features of novelty in this invention consist in so treating cotton waste, hair, wool, hides, skins, and oleaginous seeds with petroleum spirit, benzoline, or other similar product of petroleum having an affinity for grease, and in suitable apparatus, as to remove and preserve all the oil, grease, or other fatty matter from the same; and in the case of skins and hides to prepare the same for tanning, also in treating hides and skins for the removing of the hair or wool by the application of sulphide of lime as described, and in submitting cotton and other fabrics to the action of petroleum spirit for the prevention of mildew.

Improvements in separating zinc, copper, or other ores or materials from carbonate of iron, and in apparatus employed therefor. Frederick John King, merchant, Bishopsgate Avenue, London. July 29, 1873.—No. 2574. My invention consists in effecting the separation of ores, such as zinc or copper ores from carbonate of iron, by first subjecting the ores or materials to be separated to the action of heat in closed or partially closed retorts, or in any furnace in which air is practically excluded during the roasting process, whereby the carbonic acid is removed from the iron, the iron being thereby changed to a magnetic state; and then passing the roasted ores over a revolving wooden wheel or roller, on the circumference of which are placed rings of iron or steel, each alternate ring being in contact with the opposite poles of a number of magnets inserted in the wheel or roller, a continuous band of silk or other textile fabric, or any material through which the magnetic power will pass, being passed around this wheel by means of a second wheel or roller, or other convenient arrangement, drawn away from contact with the magnetic wheel or roller for a short distance during its revolution. The ores prepared as above described being passed through a hopper, or otherwise passed upon the band around the magnetic wheel or roller, the magnetic particles are carried to the point where the band leaves the magnetic wheel or roller, and then drop into a receptacle for the iron, while the non-magnetic zinc, copper, or other ores or substances fall from the band into another receptacle.

Improvements in the treatment of sulphur ores. Alexander Angus Croll and David Croll Dalgairns, civil engineers, Coleman Street, London. August 1, 1873.—No. 2608. Sulphur ore is found largely combined with other foreign matters, and, by the process generally adopted for its separation by heat, a very large percentage of the pure sulphur is lost, and very injurious effects are produced on surrounding vegetation by the escape of the noxious volatile products. To remedy these evils, the portions of sulphur ore mixed with other foreign matters are separated from such as may be generally of a purer quality, and these impurer or mixed parts are reduced to a pulverised state, and thoroughly mixed, by agitation or otherwise, with water, and separation of the particles is effected according to their different specific gravities, and the sulphur becomes separated from the other matters. The particles so separated according to their different specific gravities may be drawn off at different heights from a suitable reservoir. Muriatic or other acid may be employed to combine with the foreign matters and assist separation.

NOTES AND QUERIES.

An Observation.—Some time ago I made a solution of phosphorus in bisulphide of carbon. After a few weeks, there had collected at the bottom of the bottle a bright yellow flocculent precipitate, which gradually increased in amount. Attempting to remove the stopper for the purpose of examining the precipitate, I found it immovable, and, on the application of a little extra force, the head of the stopper broke off. I then took the bottle to the top of the sea-wall, and threw it with some violence down on a stone just projecting out of the sea. The moment the bottle broke, the mixture took fire, with a slight explosion, and a cloud (presumably of phosphoric acid) was produced. This seems the more strange because the original solution, when poured on blotting-paper, always required several seconds to ignite.—JOHN E. WRIGHT, Penzance, May 18, 1874.

Valuation of Salt-Cake.—Mr. Walter Tate, in his last letter on salt-cake, considers the method for testing free HCl which Mr. Simmonds was, I believe, referring to in a former communication, as decidedly objectionable, because the loss of weight is due to an equivalent amount of H₂SO₄, and not to HCl itself. But what hinders him, may I ask, to calculate the loss of H₂SO₄ into the formula of HCl?—J. O., Bordeaux, May 18, 1874.

MEETINGS FOR THE WEEK.

TUESDAY, 26.—Civil Engineers, 8.
Anthropological Inst., 8.
WEDNESDAY, 27.—Society of Arts, 8.
Geological, 8.
FRIDAY, 29.—Royal Institution, 8.

TO CORRESPONDENTS.

J. Nermos.—Write to Messrs. Negretti and Zambra, Holborn Viaduct.

Luctor.—1. Nitrogen is easily compressible. 2. It would burn more intensely.

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Royal Polytechnic.—Notice to Everybody.—
If you want SCIENCE, you can have it. If you want INSTRUCTION, you can have it. If you prefer AMUSEMENT, you can have it. You can have either, or all three, by paying the Admission Fee of One Shilling!—The Easter Programme contains:—1. ECONOMY OF GAS; SEEGER'S New Apparatus.—2. Something more about SUGAR; New Lectures, by Professor GARDNER.—3. The WONDERS OF ACOUSTICAL SCIENCE; New Lecture, by Mr. J. L. KING.—4. LATEST NEWS FROM ASHANTEE; New Lecture, by Mr. B. J. MALDEN.—5. SIR WALTER RALEIGH'S DREAM! QUEERER THAN EVER! This Historical Incoherency has been re-written by Dr. CROFT, and will be produced with new Songs, Dresses, Effects, and Appointments. Daily at 4 and 9, by Mr. J. OSCAR HARTWELL.—Many other Entertainments.—Open 12 and 7. Carriages at 5 and 10.

THE CHEMICAL NEWS.

VOL. XXIX. No. 757.

ON THE ESTIMATION OF ALUM (ALUMINA) IN BREAD.

By A. DUPRE, Ph.D.

THE separation of pure alumina from the constituents of bread-ash, for the purpose of accurate quantitative estimation, is a tedious and somewhat difficult analytical process. Fortunately, this is quite unnecessary, if our object is simply to estimate the amount of alumina contained in a bread-ash. For this purpose, it is sufficient if we separate the alumina in the form of a compound of constant composition. The phosphate of aluminium is such a compound, and admits of easy and perfect separation from the phosphates of magnesium, calcium, and iron, by which it is accompanied in bread-ash. It has, besides, the advantage of weighing about two-and-a-half times as much as the alumina corresponding to it. The process is carried out as follows:—

One hundred grammes of bread (crumb only) are carefully incinerated in a platinum dish. The ash is fused, in the dish, with about three times its weight of pure carbonate of sodium, or of a mixture of the carbonates of potassium and sodium in equal proportion. The incineration and fusion are best performed in a muffle. The fused mass is dissolved in hydrochloric acid, and the solution is evaporated to dryness. The residue is re-dissolved in acid, and the silica filtered off as usual. To the filtrate ammonia is added until a slight permanent precipitate is produced, which is then re-dissolved by about six drops of strong hydrochloric acid. A slight excess of acetate of ammonium is now added, and the mixture is set aside overnight. Next morning, the precipitate formed is filtered off, washed, and re-dissolved in hydrochloric acid. The solution is boiled for a few minutes with a small quantity of bisulphite of sodium, an excess of caustic soda is added, and the boiling continued for a few minutes longer. The precipitate, chiefly magnetic oxide of iron, is filtered off, the filtrate is rendered feebly acid by hydrochloric acid, and acetate of ammonium added in slight excess. After standing overnight, the precipitate, now consisting of pure phosphate of aluminium, is collected on a filter, washed, dried, ignited, and weighed. By multiplying its weight in grammes by 542, the number of grains of potash alum contained in 2 lbs. of the bread examined, or rather the number of grains of alum corresponding to the amount of alumina present in 2 lbs. of the bread, is obtained. Instead of separating the iron as above, we may also re-precipitate the two phosphates a second time by the addition of acetate of ammonium, and weigh them together. The iron contained in the precipitate is then estimated by a standard solution of bichromate of potassium, and the amount of phosphate corresponding to it subtracted from the total, leaving, of course, the amount of phosphate of aluminium.

In precipitating the phosphates of iron and aluminium in the above manner, from a solution containing a large proportion of phosphate of magnesium, slight traces of this latter are always carried down, even if the precipitation takes place in the cold. In order to remove this impurity, it is necessary to dissolve the first precipitate and re-precipitate it a second time, as above directed. If the precipitation takes place at the boiling temperature, the phosphates of both magnesium and calcium are partially precipitated.

It has been stated that, during the evaporation of a solution containing alumina and hydrochloric acid, chloride of aluminium is volatilised. It has further been asserted that alumina is dissolved, during the evaporation

of the acid solution, in a porcelain dish. I have found both these assertions to be without foundation. Among many experiments made to test these points, I may mention the following:—Three equal portions (50 c.c.) of a dilute solution of alum were taken. In the first, the alumina was estimated directly. To the second and third portions 3 grms. of carbonate of sodium were added (about the amount used for fusion with the bread-ash), after which they were acidified with hydrochloric acid, and evaporated to dryness over an argand-burner in a platinum and porcelain dish respectively. To the dry residues half an ounce of strong hydrochloric acid was added; this was again evaporated, and the process repeated twice more. Finally, the alumina in the residues was estimated. The following are the results:—

1st portion contained 0.688 grm. of alum.
2nd " " 0.690 "
3rd " " 0.688 "

In conclusion, I give, in the tables below, the results of some experiments made with various samples of bread and flour to which I had myself added different proportions of alum. These tables will, I believe, show that both the processes described above leave little or nothing to be desired on the score of accuracy, and both are easy of execution. It will be seen, however, that both the bread and the flour contained a small amount of alumina. (The two samples of flour used were bought at shops widely apart.) Whether this was due to an adulteration of the flour, or whether it represents a normal constituent of the flour, I have not been able to ascertain. However this may be, I am of opinion that no baker should be punished in whose bread the amount of alumina found corresponds to less than 10 grains of potash alum in the 2-lb. loaf; unless, indeed, there is direct evidence of adulteration by alum entirely independent of the result of the analysis.

TABLE I.—100 grms. of bread taken.

No.	Weight of Mixed Phosphates.	Phosphate of Iron.	Phosphate of Aluminium.	Corresponds to Alum in 2-lb. Loaf.	Alum added to 2-lb. Loaf.	
					Calculated.	Found.
	Grm.	Grm.	Grm.	Grs.	Grs.	Grs.
1.	0.0490	0.0114	0.0376	20.38	16.64	14.53
2.	0.0373	0.0114	0.0259	14.04	8.42	7.18
3.	0.0308	0.0128	0.0180	9.76	4.13	3.90
4.	0.0236	0.0128	0.0108	5.85	0.00	—

TABLE II.—80 grms. of flour taken.

No.	Phosphate of Aluminium Found.	Corresponds to Alum in 2-lb. Loaf.*	Alum added to 2-lb. Loaf.*	
			Calculated.	Found.
	Grm.	Grs.	Grs.	Grs.
1.	0.0442	23.96	19.19	17.89
2.	0.0200	10.84	5.75	4.74
3.	0.0112	6.07	0.00	—

INFLUENCE OF CHANGES IN BAROMETRIC PRESSURE ON THE PHENOMENA OF LIFE.

M. BERT has lately brought before the Paris Academy some additional facts in connection with this subject.

He had shown that animals subjected in closed vessels to pressures between 2 and 10 atmospheres died from poisoning by carbonic acid, which they themselves produced. He has further studied these toxic effects.

For sparrows, the law was that the animals died when the centesimal proportion of carbonic acid in the air, multiplied by the number of atmospheres, gave a product varying from 24 to 28. The same figure is obtained, and the same symptoms occur, when a sparrow dies in an atmosphere at normal pressure, and sufficiently rich in oxygen for the animal to have always enough at its disposal.

* On the assumption that 80 grms. of flour give 100 grms. of bread.

Accordingly, with a view to studying the effects in question, he made dogs breathe in a caoutchouc bag, containing about 50 litres of super-oxygenated air at ordinary pressure. Death took place in four or five hours, when the air of the bag contained 35 to 45 per cent of carbonic acid.

The phenomena were, briefly, as follows:—

(1). The arterial blood contained abundant oxygen till death (when the gas-volume was 10 or 12 per cent that of the blood); the carbonic acid increased, but less and less rapidly; near the end it had reached the large proportion of 110 to 120 volumes, not far from the limit of saturation.

(2). The number of respirations quickly diminished, without proportional increase in depth.

(3). The pulsations fell still more rapidly, but continued some minutes after breathing ceased. The cardiac pressure was high all along.

(4). The temperature fell with wonderful rapidity, being at last in the rectum 24° or 28° , while the surrounding temperature was 15° or 18° .

(5). When the arterial blood contained about 80 volumes of carbonic acid, the animal became insensible, except in the eye, which did not lose sensibility till 100 volumes. The animal was quiet throughout.

(6). The motor nerves and muscles retained their properties after death.

(7). The tissues were charged with carbonic acid; muscles, *e.g.*, which usually contain 15 to 20 volumes of the gas, being found to have about 60. The urine contained even 100. The same phenomena were obtained with compressed air.

A comparative experiment was made as follows:—Four sparrows were placed in closed vessels—A in air at 6 atmospheres, B in super-oxygenated air, C in ordinary air, D in air at $\frac{1}{2}$ an atmosphere. Analysis showed that 100 grms. of the bodies of these animals contained—A, 33 c.c. of CO_2 ; B, 36; C, 17; D, 0. D died from simple privation of oxygen, A and B by carbonic poisoning, C by ordinary asphyxia. In ordinary asphyxia, the part played by carbonic acid is to be considered as quite secondary; it does not greatly accumulate in the blood or tissues. It was observed that the maximum of carbonic acid in the blood was attained considerably before death.

With regard to poisoning by carbonic acid, M. Bert makes several remarks. The organism being nearly saturated with the gas, the latter acts on the nervous centres, and causes death by cessation of the respiratory movements. The fact that no convulsive movement preceded death disproves the theory that the general convulsions in asphyxia, hæmorrhage, &c., are due to carbonic acid in excess in the blood or the tissues. They are due to the spinal cord being quickly deprived of oxygen.

From the curve expressing absorption of external oxygen, it appears that during the first hours this absorption is normal and regular, and yet the temperature diminishes; the intra-organic oxidations furnishing heat become less intense as the blood and tissues are charged with carbonic acid. The action of carbonic acid formed gradually by the organism itself is very different from that of the gas respired at once. M. Bert has previously shown that, if two young rats be placed, one in carbonic acid and the other in nitrogen, the heart of the latter continues to beat for more than a quarter of an hour, while that of the former is arrested in two or three minutes.

The persistence of the heart beats above referred to, and the maintenance of the cardiac pressure, removing all fear of syncope, appear to M. Bert to deserve the attention of surgeons, with reference to employing, as an anæsthetic, carbonic acid, produced by respiration in a closed vessel. At a moment when there was no danger of the animal's life, one might squeeze its paws, or pinch various members, without calling forth any sign of pain or reflex movement.

The facts hitherto communicated have all related to

the animal kingdom. M. Bert has, however, extended his researches to plants.

He commenced with germination, the phenomena of which are closely allied to those of animal life. The seeds he experimented with were those of barley and corn (farinaceous albumen), and of cress and radish (no albumen).

Diminution of Pressure.—In dilated air, germination is slower as the pressure is less. The difference, as shown in the number of seeds germinating, begins to appear from a pressure of 50 centimetres. The inferior limit at which germination can take place is, for cress, about 12 centims., and for barley 6. At the latter pressure it was found, *e.g.*, that of twenty grains of barley only two germinated. They reached a height of 6 centims., while those sown at normal pressure measured 12. At 4 centims. pressure there was no germination.

The grains thus kept without germination were not killed, but germinated, as usual, when restored to normal pressure.

Experimenting as to whether this disturbance of the germination was due to barometric pressure, or to the tension of oxygen alone, he found:—

(1). That germination in an air containing little oxygen, but at normal pressure, is less rapid than in ordinary air.

(2). That germination under low pressure, but in super-oxygenated air, is as rapid as in normal air at normal pressure.

(3). That germination may be obtained at a pressure of 4 centimetres by employing super-oxygenated air.

(4). That the inferior limit of germination observed by Huber and Senebier in air containing little oxygen almost corresponded to that which he had indicated for atmospheric pressure. Germination, according to them, ceased, in lettuce-seeds, when there was about $\frac{1}{4}$ th of oxygen. Now the 7th of 76 centims. is about 11 centims.; minimum tension for the seeds of cress.

Germination, then, takes place less quickly in expanded air, and this arises from the weak tension of oxygen.

Increase of Pressure.—Here it is necessary to distinguish experiments made with closed vessels, from those in which the air is so frequently renewed that it may be considered pure.

In the former case, there is added to the influence of compressed air that of carbonic acid produced. Now, for seeds, as for animals, the toxical influence of carbonic acid is measured by its tension, so that at 2 atmospheres the proportion which arrests germination is about 10 per cent, and at 10 atmospheres about 2 per cent. Curiously, the toxical tension of carbonic acid is expressed by nearly the same number for both plants and animals.

Consider, now, the effects of compressed air renewed morning and evening, and thus kept pure. Till 4 or 5 atmospheres there is little to note. From 5 atmospheres, it becomes evident that the compressed air is unfavourable to germination, especially in the case of barley. This germinates more slowly, and the sprouts are pale and thin. At 8 atmospheres the stem does not grow, but only the root. At 10 atmospheres, the seeds of cress do not sprout; and there is only a slight commencement of radicle from the seeds of barley.

If, after some days' confinement in compressed air, and when barley-seeds sown at the same time have given sprouts of 5 to 6 centimetres, the seeds are returned to normal pressure, those of barley are found to be dead—do not germinate; those of cress, on the contrary, commence to germinate after long delay.

If sprouts of barley or of cress in full growth are subjected to pressure, the barley stops and quickly dies; the cress resists much longer.

Here, again, analysis of the phenomenon shows that this remarkable action of compressed air is due to too great tension of oxygen. For—

(1). Seeds of barley and cress placed in super-oxygenated air at normal pressure behave like those in compressed air. Thus, at about 60 per cent it is difficult to note any

difference; but about 80 or 90 per cent (corresponding to 4 or 4.5 atmospheres) it becomes evident that the barley-seeds are developed very much less than in ordinary air; the cress-seeds are less affected.

These facts confirm the results obtained by Huber and Senebier, and which some physiologists have questioned.

(2). If super-oxygenated air be employed under pressure, we have, *e.g.*, at a pressure of two atmospheres, for an air with 90 per cent of oxygen (oxygen tension $2 \times 90 = 180 = 9$ atmospheres), the same results as with 9 atmospheres of air.

(3). If compression be produced in air containing little oxygen, so that the tension of this gas does not exceed that of ordinary air at 2 or 3 atmospheres, the germination takes place regularly.

To sum up:—

(1). With diminution of pressure, germination takes place more slowly the lower the pressure. It ceases finally between 4 and 10 centimetres, without the seeds, thus kept inactive, dying. There is evidently an arrest of the oxidations necessary to development of the embryo, owing to the too weak tension of oxygen.

(2). With increase of pressure to 2 or 3 atmospheres, there seems to be a slight advantage for seeds in the compressed air; but, from 4 or 5 atmospheres, there is evident disadvantage, especially to seeds with farinaceous albumen. Lastly, at very high pressures, the seed is killed by being kept in the compressed air; it is also killed when subjected to compression after its development has commenced. This is due to the too great tension of oxygen retarding the oxidations, as in the case of animals. If the alterations in the compressed air be examined, it will be found that the consumption of oxygen has been much less than at normal pressure.

The present communication seems to offer a solution of certain important questions connected with the geographical distribution of plants, &c.

RESEARCHES ON THE FORMATION OF SUPERPHOSPHATE OF LIME.

By M. J. KOLB.

IN the manufacture of superphosphate the reaction is generally supposed to take place in accordance with the following equation:—



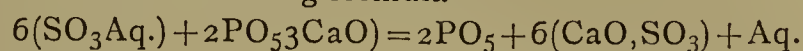
and the fluctuating results are ascribed to incidental circumstances. The author considers that the reaction is less simple. If we take 1 equivalent of pure tribasic phosphate and 2 equivalents of sulphuric acid at 53° (Baumé?), and mix them intimately, there is a rise of temperature of 120° to 150°, whether we operate on the large or small scale. Under such circumstances an acid phosphate cannot be formed for three reasons.

(1). Monocalcic phosphate, even in solution, if exposed to a temperature of 100° is partially decomposed, and gives a precipitate of bicalcic of pyrophosphate.

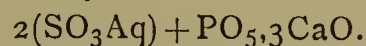
(2). Between 120° and 150° sulphate of lime becomes anhydrous, and then decomposes monocalcic phosphate, even in solution, absorbing the water necessary for the existence of the latter.

(3). If sulphuric acid is brought in contact with a mixture of monocalcic and tricalcic phosphates, it leaves the tricalcic untouched, and decomposes first the monocalcic phosphate. Therefore when sulphuric acid is gradually poured upon tricalcic phosphate, as is done on the large scale, the first portions of the acid phosphate formed would be in contact with sulphuric acid and be decomposed, even if they escaped the action of heat and of the anhydrous sulphate of lime. Deherain supposes that superphosphate is phosphoric acid mixed with sulphate of lime. Milliot and Joulie have already pointed out the existence of free phosphoric acid in superphos-

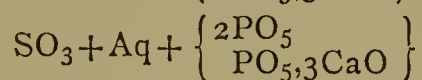
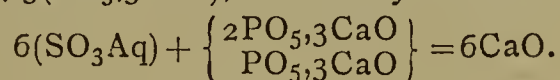
phates. On taking 100 parts of tribasic phosphate of lime and 95 parts of sulphuric acid at 53° we have the conditions of the following formula—



Experiment gave 43 to 44 of free phosphoric acid, whilst the formula would indicate, theoretically, 45.7. Deherain would, therefore, be right if such proportions were employed, but as they give an unmarketable puddle, practical operations are based upon the formula—



If we take pure products, calculated upon this formula, and analyse the result, at first a few moments after mixture whilst the mass is still hot, and then at successive intervals of fifteen minutes or an hour, we find that the free phosphoric acid, at first very considerable, constantly decreases, whilst that of acid phosphate of lime progressively increases. It is then plain that phosphoric acid is formed at first, and that it is gradually converted into acid phosphate. If we triple the formula $2(\text{SO}_3\text{Aq.}) + \text{PO}_5,3\text{CaO}$, to render it comparable with the foregoing we shall have $6(\text{SO}_3\text{Aq.}) + 3(\text{PO}_5,3\text{CaO})$, which may be written—



We have, thus, phosphoric acid present along with tribasic phosphate. Joulie maintains that free phosphoric acid transforms tribasic phosphate into bibasic phosphate. The author, having made many experiments with acid in different proportions and degrees of concentration, was unable to verify this fact, but found, on the contrary, that at common temperatures phosphoric acid, even in presence of an excess of tribasic phosphate, yields monocalcic phosphate. If heat is applied the case is different, the monocalcic phosphate, as fast as formed, being decomposed into free acid and bicalcic pyrophosphate. The formation of superphosphate is then composed of two stages—The liberation of two-thirds of the phosphoric acid; and, secondly, the attack of the untouched tribasic phosphate by the phosphoric acid set free in the former stage. There is no marked interval between these two stages of the reaction.

The sulphuric acid is commonly employed at 53°, that is with 4 equivalents of water, since it has to furnish not merely the water of hydration for the sulphate of lime, but that needful for the existence of monocalcic phosphate. —*Comptes Rendus.*

SOFT-SOAPS AND THEIR SOPHISTICATIONS.

By Dr. VOHL.

SOFT-SOAPS are potash-soaps prepared with animal oils, or with the oils of seeds poor in stearic and margaric acids. The oleine obtained as a by-product in the manufacture of stearine candles is also used in their preparation. Manufacturers distinguish the oils as hot or soft, and as cold or hard. The former, which comprise the oils of linseed, sesame, and hemp, yield a soap which does not become turbid in winter from the formation of stearic and margaric compounds. Soaps made with the "hard" oils, like those of cabbage, colza, beet-root, and train, have that inconvenience, and are therefore used for summer consumption. Oleine is, from the same reason, used for summer soaps. The method in which these soaps are prepared indicates that their composition is different from that of soda-soaps. In the latter the glycerin is removed, whilst potash-soaps, if prepared directly with animal or vegetable oils, invariably contain glycerin. The soft soaps made with oleine are, of course, free from glycerin. Glycerin communicates to soaps certain properties which are wanting where it is absent. It renders them stronger and less rich in fatty matter, which justifies the opinion

of woollen manufacturers that soaps prepared directly from oils are less adapted for "milling" cloth than the oleine soaps. Attempts have been made to replace the fatty acids with resin, and the potash with soda. Experience shows that an addition of 10 per cent of resin to the oil before saponification, or 4 per cent in the finished soap, does not injure the quality and the effects of the soap. If the amount reaches 15 per cent (on the oil) it must be regarded as an adulteration. Soaps adulterated with soluble glass and starch contain 25 per cent of resin. The substitution of soda for potash must be kept within narrow limits. Soft soaps containing soda in the proportion of 1.5 to 2 per 100 parts of potash are not in the least deteriorated. The chief adulterations are practised in order to increase the weight of the soap, and enable it to take up and retain an excessive proportion of water. The substances chiefly used are silicate of soda, farina, and infusorial earth. Some manufacturers employ all these substances simultaneously. In this manner 100 parts of oil are made to yield 370, and even 400 of soap. These impurities attack the fibre of tissues both mechanically and chemically, and often destroy colours entirely. Silks and pure wools are most injuriously affected; linen, and mixtures of hemp and wool less so. It was found experimentally that cottons, after washing with these soaps, contained a considerable quantity of silica, which was not previously present. Lint made from linen which has been washed with silicated soaps is unfit for surgical uses, as it irritates all wounds, &c., to which it is applied. The value of a soft soap depends exclusively on its richness in oleate of potash. Hence, in analysing an unadulterated soap it is merely requisite to determine the fatty acid, and the potash, and to calculate the difference as water and glycerin. In the examination of a soap it is therefore necessary to ascertain, by a preliminary qualitative analysis, whether the sample is adulterated or not. The soap is dissolved in hot distilled water. If it dissolves without residue it is a good sign, as clay, infusorial earth, and all other insoluble substances are thus excluded. A small amount of blue, black, or greenish matter deposited after long standing is the result, not of intentional adulteration, but of the colouring matters added. The clear liquid is then mixed with dilute hydrochloric acid until it has a strongly acid reaction. Observe if the neutralisation is accompanied with effervescence, and if the gases given off smell of sulphuretted hydrogen. The mixture of soda-lye and of hydrochloric acid is best made in a glass funnel with a ground-glass tap fitted into its neck. Light petroleum oil (canadol) is then added, and the whole is briskly stirred up. When the canadol, which holds in solution the fatty acids and a part of the resin, is separated the tap is opened, and the acid aqueous liquid allowed to flow out. A part of this acid liquid is diluted with water in a test-tube, and mixed with iodised water, or a weak solution of iodine in iodide of potassium. If a blue colouration is produced the soap contains farina. The rest of the liquid is carefully evaporated to dryness in the water-bath; the residue is moistened with strong hydrochloric acid, the excess of which is driven off by a gentle heat in the water-bath. The residue is then washed upon a filter, and completely exhausted with distilled water. It is then dried and ignited in a platinum capsule. If a slight white residue remains silica was present in the soap. In other words, it has been falsified either with soluble glass or with infusorial earth. To distinguish these two substances the microscope is needed. With a magnifying power of 400 diameters the characteristic shields of the infusoria can be recognised. The silica precipitated from soluble glass is amorphous. The filtrate from the precipitate is evaporated to dryness in the water-bath; the residue is extracted with a mixture of equal parts of alcohol and ether, and the solution heated in the water-bath to expel the solvents. The residue is exhausted with water, a neutral solution of chloride of copper is added, and an excess of caustic potash. If the soap contains starch or glycerin there is formed a fine blue liquid. This is poured

into a retort, and heated in the water-bath as long as a yellow or red precipitate is formed. If the liquid becomes colourless more solution of chloride of copper is added until it takes a decidedly blue colour, when it is heated anew in the water-bath till a precipitate is formed. After this a few drops of basic acetate of lead are added to remove a variety of organic matters. The mixture is filtered, and the liquid precipitated with an excess of sulphide of potassium. The precipitate is filtered off, and the filtrate, after being neutralised with hydrochloric acid, is evaporated to dryness in the water-bath. The residue is extracted with etherised alcohol. On evaporating away the solvent pure glycerin remains. If none appears no glycerin was present in the soap. The residue of the filtration extracted with etherised alcohol is calcined in a platinum capsule. The residue extracted with water is tested for soda with the antimoniate of potash. The solution of the fatty acids in canadol, mentioned above, as soon as it has become clear is poured into a tall glass cylinder with nine or ten times its volume of pure canadol. If the liquid becomes turbid resin is certainly present, which, after a time, is deposited at the bottom of the glass as a brown viscid mass.

Quantitative Determination of Water in Soft-Soaps.—A certain quantity of the soap, 6 grms., is weighed between two watch-glasses, the edges of which are ground and fit air-tight, whilst the glasses are held together with a brass clip. The lower glass, which contains the soap, is placed in an air-bath heated at first to 100° C., where it is left until the weight becomes stationary. The loss is, of course, water. In adulterated soaps a direct determination of water is necessary.

Fatty Acids.—Dissolve in hot distilled water a known weight of the soap, 10 to 12 grms. Add to the solution hydrochloric acid until the mixture has a decided acid reaction. Cool the mixture down to 20° C., and add a quantity of canadol equal in weight to the soap. Agitate it carefully, and separate the layer of canadol from the acid liquid by means of a funnel with a tap ground in its neck. The acid is repeatedly shaken up with fresh portions of canadol. The various oily extracts are poured into a beaker of known weight, and the canadol is evaporated off at a gentle heat. Lastly, the beaker is placed in a water-bath, or hot-air bath, and the fatty acid finally remaining is weighed. If it is desired to determine the resin the fatty acid is re-dissolved in canadol, and more canadol added as long as the liquid is rendered turbid. The whole is then allowed to settle. The clear portion is decanted off, and the fatty acid determined as above. The difference gives the resin.

Determination of Silica.—For the insoluble portion, 10 grms. of the soap are dissolved in hot distilled water, and the solution is filtered. The sediment which remains on the filter is washed, first with water, and then with dilute hydrochloric acid, then again with water. It is next dried and ignited in a platinum capsule. The weight of the residue, less the ash of the filter, gives the amount of insoluble silica in the soap. The soluble silica is determined in the filtrate and washings from the last operation. The whole is supersaturated with hydrochloric acid, and evaporated to dryness in the water-bath. The residue is moistened with concentrated hydrochloric acid, and heated anew on the water-bath to drive off excess of acid, exhausted with distilled water, and thrown upon a filter. What remains on the filter is carefully washed, dried, and ignited in a platinum capsule. The weight after ignition, less the ash of the filter, gives the amount of silica which has been present in the soluble state.

Determination of Alkalies and Acids.—For this determination we use the filtrate and washings from the soluble silica. This liquid is poured into a platinum capsule and evaporated to dryness in the water-bath, and heated till the residue is completely white. It is then dissolved in distilled water, filtered if necessary, the filtrate evaporated to dryness in a platinum capsule, ignited, and weighed. The weight of the residue gives the alkalies and alkaline

chlorides contained in the soap. If sulphuric acid is present it must, of course, be previously removed in the ordinary manner. The alkaline chlorides are mixed with a saturated solution of chloride of platinum, evaporated to dryness in the water-bath, and washed with strong alcohol upon a filter, dried at 100°C ., and weighed. The weight of the residue dried at 100°C . gives the alkalies of the soap. The quantity of chloride of potassium corresponding to the potash having been deducted from the total of alkaline chlorides found, the residue is chloride of sodium, from which the soda present in the soap may be calculated. The method of determining the respective amounts of alkali combined with fatty acids, or present in the caustic or carbonated state, will be given on another occasion.

Determination of Starch.—The quantitative determination of starch is difficult to perform directly, whence it is generally found indirectly along with the glycerin. If a direct determination is required, 10 grms. of the soap are dissolved in 200 to 300 c.c. of distilled water, and sulphuric acid is added until the reaction is slightly acid. The liquid is then boiled, the water evaporated being constantly replaced, until all the starch has been transformed into sugar, and no longer reacts with iodine. The liquid is then neutralised with chalk or carbonate of baryta, and filtered. The sugar is then found either by fermentation, or by Fehling's method with an alkaline solution of copper. To determine glycerin directly, a known weight of soap is dissolved in distilled water, mixed with an excess of acetate of lead, and boiled. It is then filtered, and the filtrate is treated with a current of sulphuretted hydrogen until all the lead is thrown down. The sulphide of lead is filtered off, the filtrate evaporated to a syrup in the water-bath, and the residue extracted with absolute alcohol or etherised alcohol. The alcohol is then evaporated, and the glycerin remaining behind is weighed.—*Moniteur Scientifique*.

ON SOME
RECENT PROCESSES FOR THE MANUFACTURE
OF SODA.*

By C. W. VINCENT, F.C.S.

(Concluded from p. 227).

MANY of the rudimentary processes when practised with modern apparatus yield far better results than in the hands of the original inventors. As a last instance I cite the process for making salt-cake (sulphate of soda), by roasting together common salt with an excess of pyrites. This process was known as Longmaid's, and was patented by him in 1842, but had been in use on the Continent many years previously. This process being unprofitable, the next step taken in the direction was to pass sulphurous acid from the pyrites burners, together with air and steam, over common salt and oxide of iron. This was by Mr. Robb, in 1853. Four years latter Brooman took out his patent which dispenses with the oxide of iron. This process has in it the elements of success; it is at present being carried on on a large scale at the Atlas Chemical Works, Widnes, by Mr. Hargreaves. The salt, which may be crushed rock salt, is mixed with sufficient water to be moulded into bricks, and is then piled up in heated chambers, into which sulphurous acid, steam, and air are passed. Hydrochloric acid is evolved and condensed in the usual way. Mr. Hargreaves states the amount of fuel used to be one-third of that required by the sulphuric acid process, as the gases are passed into the chambers directly from the burners at a red heat, whilst the heat developed by the reaction of the sulphurous acid upon the salt also assists in maintaining the temperature. No nitrate of soda is required in the process, and thus a very costly item in the manufacture of soda is removed. The temperatures at which the materials are to be maintained do not exceed from 800° to

900°F . and are therefore not high enough to cause much destruction of the apparatus. In fact, the wear and tear is quite inappreciable.

The alkali trade still awaits the coming man, and if one may venture an opinion, it is not a new process that is required so much as improvements upon the old. The by-products of Le Blanc's process have attained such importance that they constitute distinct manufactures in themselves, and if, instead of being by-products, they had to be purposely made, their cost would be much added to. The grave defect of the Le Blanc process is the great loss of available soda. Taking the best commercial sulphate of soda to contain 97 per cent of pure sulphate, the amount obtained in the soda-ash falls very far short of that indicated by theory. According to Mactear, this loss throughout the alkali trade averages 13.75 per cent. I am informed that on the Tyne it is never less than 10 per cent, and more frequently 15 per cent; and, more than this, that makers find it at times a matter of very great difficulty to produce soda-ash of 54 per cent alkali. This serious loss of soda is due to several causes, but, as might be expected, it is in the treatment of black-ash that the greatest loss occurs. Of necessity some soda must be lost by retention in the waste, and also by careless manipulation of liquors and salts, or by imperfect lixiviation; but all losses through these causes fall far short in well-conducted works of the large amount to be sought for, an average of 13.75 per cent.

Scheurer-Kestner was the first to discover the real cause of the evil. By close examination and analysis of vat waste, he was led to the conclusion that at least 5 per cent of the loss, and frequently very much more, is due to insoluble compounds formed by the soda being kept in prolonged contact with water and the sulphides of the waste. If this cause be a true one, it is manifest that the lixiviation must be greatly accelerated. Further investigation proved decisively that in addition to this a further cause of the loss is the presence of an excess of chalk in the black-ash mixing, which is converted into lime in the furnace. When water is added, the hydrate of lime reacts upon the carbonate of soda, and renders part of it insoluble. Black-ash obtained on the large scale from 100 sodium sulphate and 95 limestone, left a tank waste containing on the average 0.39 per cent sodium, whilst a product made from 100 sulphate and 112 limestone, left 1.36 per cent sodium in the waste. This average was not appreciably affected by using sometimes a mixing coal, having 18 to 20 per cent of ash, and sometimes one having 10 to 12 per cent ashes. The natural inference is that the quantity of limestone in the mixture for soda-ash ought to be reduced to the lowest point consistent with the quality of the ash.

It has become the fashion of late years to speak of the present mode of manufacturing soda as a roundabout process, but fairly looked at I must say—though I risk bringing a storm of negations upon my head from the favourers of all the so-called direct processes—that in a great measure it derives this character from the vastness of the connected processes.

To make the sulphate, sulphuric acid has to be manufactured on a gigantic scale, but the surplus acid is in itself a source of profit. The cheapest sulphur is found in pyrites containing copper. In order to save carriage it is found profitable to smelt the burnt ore to a regulus containing 10 to 12 per cent of copper, another manufacture, and another profit.

By the action of the sulphuric acid on the salt, hydrochloric acid is set free. Here is another profitable product. A small part of the acid is used to act on limestone to furnish the additional equivalent of carbonic acid required to convert carbonate into bicarbonate of soda; part is sold, but by far the larger portion is run upon bin-oxide of manganese, and supplies the chlorine for bleaching-powder making. Of late an additional process has been added, for Mr. Weldon has pointed out the means of recovering the manganese, so that it can be used over and over again with but a small percentage of loss.

All these varying industries proceeding together, upon

* A Paper read before the Society of Arts, Chemical Section, April 10, 1874.

premises nominally for the manufacture of soda only, give to the Le Blanc process an air of complexity with which it should not justly be credited. Indeed, the true effect of this is that so many additional profits are brought in, that the cost of soda-making proper is reduced far below what it appears to be. Not in our day do I even hope for its being as a whole replaced, however much it may be modified.

Thus far chemistry; but, though so important that these are called, *par excellence*, "chemical works," it does not stand alone. Engineering, mechanics, and physics each have a great share in the successful carrying on of the works. Every part of the great whole must be fitted with due consideration to its performing its duty at the smallest cost of time and labour. I think it was in alkali works that the waste heat of the smelting- and other furnaces was first used upon steam-boilers; of course, to furnish the steam for the vitriol-chambers and other purposes about the works. Steam-cranes and ingeniously-devised tramways, for unloading and loading the raw materials; most careful adjustment of the various houses, so that nothing has to be carried a yard out of its way; skilful adaptations of each piece of apparatus to the end it has to fill—all these, and many more such things, testify to the grand importance of technology to the alkali-maker.

Science and technology here go side by side. The chemist has sketched out a process by which certain results can be obtained. That they are obtained, and profitably obtained, is entirely due to the technical skill that has been from time to time brought to bear upon every piece of apparatus in the works, under that keen supervision of the chemist and physicist which has so thoroughly secured its conformity with natural laws.

Nothing in the universe stands by itself; all things are interdependent; and it may be taken as an axiom in the arts, also, that no process can be improved, no branch of industry advanced, no new invention become prosperous, except by aid brought to it from without.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 21st, 1874.

Dr. ODLING, F.R.S., President, in the Chair.

AFTER the names of the visitors had been announced, and the minutes of the previous meeting read and confirmed, Messrs. A. Wolff, G. Chaloner, A. B. Allen, W. Thomson, and M. Lichtenstein were formally admitted Fellows of the Society. The donations to the library were then announced, and the names of Messrs. W. H. Wilson, Richard Apjohn, M.A., W. A. Carter, B.A., James Kilroe, Thomas Garside, James Henry Davies, George Cristopher, Charles Benjamin Caswell, and F. Stocks were read for the first time. For the third time—Messrs. Charles Edward Bean and H. H. B. Shepherd, who were balloted for and duly elected.

The PRESIDENT having called on Dr. W. H. CORFIELD to deliver his lecture "*On the Sewage Question from a Chemical Point of View*," the lecturer commenced by saying that perhaps the title had misled some into believing that he was going to treat of the chemical methods for analysing sewage and determining the amount of its various components; he intended, however, to confine himself entirely to the consideration of the sanitarian view of the matter, as illustrated by the chemical examination of the various products.

The removal of the refuse from towns, and especially excretal matter from the neighbourhood of habitations, was one of the most important sanitary problems of the day, the general death-rate at any place being in inverse proportion to the efficiency of the means used for this

purpose. He would warn them that he considered the immediate removal of excretal matters of the highest importance, since the retention of these matters near habitations for a longer or shorter period was always certain to be attended with evil consequences. All the various systems for treating sewage might be reduced to two classes:—(1) Those in which the whole of the refuse matter was removed with the foul water; (2) those where this foul water was allowed to run into the sewers, but as much of the solid matter as possible was kept back. In judging of the respective merits of these two classes in all their varieties, chemistry comes to our aid, and shows that, where midden-pits or cesspools are used, the water of the wells in the neighbourhood becomes contaminated with nitrogenous organic matter, ammoniacal salts, and chlorides, the presence of the latter in any quantity in surface waters at places not in the neighbourhood of the sea being an almost certain indicator of sewage. Of the conservancy systems, three of the most important varieties were—(1) The employment of tubs or pails with or without disinfectants and deodorisers; (2) ash closets; (3) dry-earth closets. In these the fæces were retained, and it was advocated that they would be extremely valuable as manures, especially from the latter. It was found, however, that the earth, after having been used three times in the dry-earth closets, did not contain more nitrogenous matter than a rich garden mould, viz., 0.446 per cent, and consequently its value as a manure was so small that it would only pay for carriage to a very short distance. Dr. Voelcker had estimated it to be worth about 7s. 6d. per ton. This arises from the fact that the total amount of nitrogen excreted in the fæcal matter is not more than one-fifth that in the urine, the former only containing 1.5 per cent of nitrogen. In Paris much of the excreta are collected and sent to Bondy, and there converted into a manure called "poudrette;" this costs the city annually a large sum, although the company who manufacture the manure make a profit. The system of pails or tubs, especially with the use of deodorisers, was essentially bad, as in the latter case the refuse matter might possibly be kept in houses some time, and deodorising was not the same as disinfecting.

The lecturer then passed on to the consideration of the utilisation of the sewage resulting from the removal of the whole of the excreted matters along with the foul water, stating that the amount of nitrogen in the sewage is very nearly the same in those places where water-closets are used and the whole excretal matter removed, and where the solid portion is kept back by the use of some conservancy system. The suspended matter in sewage can be removed in great part by subsidence, but the clear liquid which passes off is still sewage, and quite unfit to be sent into our streams or rivers.

Numerous processes have been proposed for the precipitation of sewage. These remove the suspended matters more or less completely, deodorise the liquid, and precipitate a portion of the phosphates; but they are ineffectual, as they only partially remove the ammonia and the organic matter which is in solution, or do not do so at all. The clear liquid, therefore, is not in a fit state to be poured into the streams; moreover the precipitate has comparatively little value as a manure.

Of the methods of employing sewage for irrigation, that of upward filtration was found to be useless; for, although the solid matters were removed, no oxidation took place, and the effluent water was consequently quite unfit to be allowed to flow into our streams. With intermittent downward filtration the case was quite different. This system was applied to the sewage of Merthyr Tydvil, a town of 50,000 inhabitants. Here the sewage was passed on to a planted filter of 20 acres, and it was found that the effluent water contained the same amount of nitrogen as it did before it passed through the soil; but it went in as ammonia, and came out as nitrates and nitrites, being completely oxidised by its passage through the soil. In the case where the sewage is simply passed over the sur-

face of the soil, where the plant growth alone acts, and not the oxidising action of a porous soil, the effluent water is always very impure. In order to purify sewage, therefore, it must be passed through the soil, and not merely over it.

The lecturer stated that experiments had been made during two years on an irrigation farm of 121 acres, to ascertain how much of the nitrogen was retained by the plants. In this farm about 25 tons of nitrogen per annum pass in as sewage, of which 10 per cent are lost in the effluent water as nitrates and nitrites, and 40 per cent were recovered in the crops during the first year. The latter number was probably too high for the average, the second year giving much less.

Dr. GILBERT, who occupied the Chair, said the Society was much indebted to Dr. Corfield for his lecture on this most important subject, in which he had touched on all the principal points. He quite agreed with the lecturer that all the conservancy methods hitherto proposed had failed, and no precipitation process had given a manure worth carrying beyond a very small distance. As we have to use water to cleanse our dwellings so as to get rid of all refuse matter, the best way was to send it into the sea, if near enough, and, if not, to adopt the method of intermittent irrigation, with or without previous treatment. The results alluded to by the lecturer as obtained from two years' experiments on a farm of 121 acres must not be relied on as an average; on a large scale, for a period of several years, the amount assimilated would probably be found to be much smaller.

Dr. FRANKLAND said he had very little to add to what Dr. Corfield had already stated in his very lucid treatment of the subject. He quite agreed with him as to the comparatively small value of the manures obtained by the conservancy systems, and he thought that the proportion of nitrogen in the solid and liquid excremental matter was rather under- than over-stated; he should himself be inclined to say that it was six or seven times as great in the latter as in the former. One point interested him very much,—namely, that the passage of the sewage through the soil purified it to a far greater extent than the plants growing in the land. He believed that this was the most effective method of treating sewage, although at the Norwood farm, which is a stiff soil and not underdrained, the state of the effluent water was quite satisfactory even in winter.

Dr. VOELCKER believed that sewage could never be made a profitable thing, and so long as that was the main thing looked to they would never arrive at a solution of the question. With regard to the utilisation of the sewage at Bondy, they profitably extracted ammonia by distillation from the liquid containing 2 per 1000, and, although the whole of the sewage was not treated in this manner, several thousand tons of sulphate of ammonia were annually produced from it. The solid was mixed with charred peat and burnt gypsum to form poudrette, but the peat actually contained more nitrogenous matter than the solid faecal matter did. The speaker also pointed out that the employment of large quantities of liquid for experiments on sewage was likely to give rise to errors, from the want of uniformity in the composition of different portions of the liquid.

Mr. HOPE remarked that he would call the attention of the meeting to the fact that, in the application of Heisch's test to the effluent water, it was found that the organisms were produced when phosphoric acid was present; he thought, therefore, that was what we should search for to ascertain the purity of the water. A farm at Crewe, of stiff clay soil, was converted into a very fair filter-bed by paring off and burning the soil to the depth of 6 inches, and then ploughing it up to the depth of 3 feet by steam. It was then laid with drains at the distance of 4 feet apart.

Dr. GILBERT said that rapidly-growing crops assimilated much of the nitrogen, but in the winter-time comparatively little was taken up. Where dry manure was applied to land on which wheat was grown for twenty-one years

successively, it was found that not more than one-third was recovered in the crop, but with barley, where it was not exposed to the winter rains, one-third was got back.

The CHAIRMAN, having thanked Dr. Corfield in the name of the Society, adjourned the meeting until Thursday, June 4, for which the following communications are announced:—(1). "On Dendritic Spots," by H. Adrien. (2). "On the Acidity of Normal Urine," by J. Resch. (3). "Note on Kauri Gum," by M. M. P. Muir. (4). "On Certain Compounds of Albumen with the Acids," by G. S. Johnson. (5). "On a Simple Form of Apparatus for Estimating Urea in Urine," by Dr. W. J. Russell and Mr. S. H. West. (6). "On Ipomœic Acid," by E. Neison and J. Bayne. (7). "On the Action of Chlorine and Bromine on Iso-Dinaphthyl," by W. Smith. (8). "On Acetyl Sulphite," and (9) "On a New Formation of Toluol," both by Dr. D. Tommasi.

CORRESPONDENCE.

INDIRECT DETERMINATION OF ALUMINIUM OXIDE IN PRESENCE OF FERRIC OXIDE.

To the Editor of the Chemical News.

SIR,—In reply to T. C. K., whose letter appeared in CHEMICAL NEWS, vol. xxix., p. 216, I beg to state that, upon looking up Church's "Laboratory Guide" (2nd edition, p. 142), I did not find any process described wherein advantage was taken of the powerful reducing action exerted by nascent hydrogen to accelerate the solution of ignited ferric oxide in acids, which is the only "new feature" I claim for the process described in my note "On the Indirect Determination of Aluminium Oxide in Presence of Ferric Oxide" (CHEMICAL NEWS, vol. xxix., p. 199). Had T. C. K. read the note referred to with a little more care than he has evidently done, he would at once have noticed the difference between the process therein sketched, and that described by Professor Church in his excellent little text-book.—I am, &c.

R. W. EMERSON MACIVOR.

Glasgow, May 26, 1874.

SALT-CAKE, OR CRUDE SULPHATE OF SODA

To the Editor of the Chemical News.

SIR,—It will be seen, on reference to my former letter on this subject (CHEMICAL NEWS, vol. xxix., p. 185), that I did *not* recommend any method for the estimation of HCl in salt-cake. I simply said that, to prevent the HCl being thrown down together with the undecomposed NaCl, on the addition of AgNO₃ the crude sulphate might first be moistened with NH₄HO and ignited. I find from experience that, if this operation is conducted properly, the loss on ignition will be simply total free acid and moisture. The undecomposed NaCl in sample not being interfered with in the least.—I am, &c.,

WM. SIMMONDS.

Oldbury, near Birmingham,
May 25, 1874.

New Couple Prepared Specially for the Application of Continuous Currents in Therapeutics.—M. Morin.—The couple is somewhat similar to that of Bunsen; but the central carbon, instead of being in nitric acid, is surrounded by a chromic salt which nearly corresponds, in chemical constitution (water excepted) to the solution of Jacobi. It is dissolved by the water bathing the zinc. The advantage of the new process is shown in that, to produce a determinate effect, the apparatus with chromate reaction is reduced to about an eighth of the volume of the sulphate of copper apparatus formerly described by the author, and in which the precipitation of copper is entirely avoided.—*Comptes Rendus.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

OTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, April 6, 1874.

Solar Cyclones ; Conclusion of Reply to Dr. Reye, &c.—M. Faye.—The author seeks to show that his theory is applicable to tornadoes as well as to trombes ; and he gives a table, constructed by Dr. Lovines, of facts concerning tornadoes in the United States. Tornadoes are simply large trombes. Like trombes they descend from the clouds in form of inverted cones, move with these clouds, pass rapidly over places which they ravage, in the heart of a calm in the lower atmosphere which is always warm and moist, the calm returning after their passage. The mechanical effects are the same, but on larger scale. They are oftener accompanied by thunder, hail, and rain. They go quite as often in groups, or, rather, in series, only the trombes are much more multiplied, and may be observed in series of six or seven. In the United States tornadoes almost all take the direction of east, and their movement of gyration is direct. The tornadoes are more nearly allied to sun-spots by their colossal dimensions, their greater duration, and similarity in direction of gyration. M. Faye further criticises a paper by M. Gautier in *Archives des Sciences*, and a passage in Mr. Lockyer's recent work on "Solar Physics."

Shocks of Earthquake in Algeria, March 28, 1874.—M. Sainte-Claire Deville.—There were two oscillations in the forenoon at an interval of eight minutes, the first and most violent lasting seven to ten seconds, and causing an inclination in the ground of about a degree. The oscillations were gentle, doing little damage to buildings.

Observations made at the Observatory of Toulouse in the Months of February and March, 1874.—M. Tisserand.—Twenty-eight series of daily observations of sun-spots were had, and drawings made. The author gives tables for two of the spots, showing the latitude and longitude, and the time of rotation.

Scientific Ascent to a Great Height on March 22, 1874.—MM. Croie-Spinelli and Sivel.—They started from La Villette at 11.33 a.m., and reached their maximum height, 7300 metres, at 1.30 p.m. The temperature (which had been $+13^{\circ}$ at the ground) was there -22° . They came to the ground again at Bar-sur-Seine at 2.12 p.m. Spectroscopic observations were made as to the two dark bands of aqueous vapour, which M. Janssen had supposed to be of terrestrial origin, while P. Secchi thought they would persist in high regions, the vapour being in the sun. The bands were both gone by the time 7000 metres was reached, M. Janssen's view being thus confirmed. The authors had also taken with them some oxygen as a counteractive to the effects of rarefaction. It proved useful, affecting the two men differently however. The effects were more marked in M. Croie-Spinelli, who is of lymphatico-nervous temperament, than in M. Sivel, a very strong man of sanguine temperament. The former, when not respiring oxygen, had at one time to sit motionless on a bag of ballast. After a dozen respirations he could rise, talk vivaciously, look attentively at the sun, and make delicate observations. The mind was accurate, and the memory excellent. The inspirations also improved his appetite and digestion, and reduced the pulse from 140 to 120. Pigeons taken up in the balloon seemed ill at ease in the high regions. The first was despatched at 5000 metres. It commenced by beating its wings, trying for a little to get back to its cage, but finding its efforts vain it descended, describing curves 200 to 300 metres diameter, and with a high velocity of about 40 to 50 metres per second. It arrived at its destination, but not for thirty

hours. The second, let off at 5200 metres, returned to its cage.

Action of Electric Fluid on Gases.—Third note by M. Neyreneuf.—Are the effects on flames due to the simultaneous action of the two electricities, or does each act separately ? To answer this interpose between the flame and the point a diaphragm (conducting or not) hindering the production of a gaseous current. The beating down is as energetic as before. The induction is shown to be propagated in curved lines. The negative electricity attracts the flame which the positive electricity repels. The author inquired whether these inverse effects are produced in gases at ordinary temperature. He inserted two points, connected with a Holtz machine, in the ends of a glass cylinder ; also two glass tubes, one of large, one of small diameter, the former conveying ordinary gas, which gave a small flame at the exterior end of the latter. He was thus able to ascertain the existence of a vibratory movement within the cylinder, due to the concordant actions of the two points ; the flame was agitated. The agitations were much greater when the electric current was in the same direction as the gaseous current, and less marked with hydrogen than with ordinary gas.

Note Accompanying the Presentation of New Astronomical Object-Glasses of Large Dimensions.—M. Secretan.—One object-glass presented was 24 centimetres diameter, its focus at 3.25 m., the price 6300 francs. He is constructing another of 21, 27, 32, and 38 centimetres diameter severally.

System of Continuous Alarm Signals to Prevent Collisions, on Railways or at Sea, in Foggy Weather.—M. de Mat.—Air is compressed in a cylindrical reservoir, from which a tubulure conveys it to three organ pipes (giving *do*, *mi*, *sol*), which can be sounded separately or together. In fog the *do* is sounded, and whenever an engine-driver hears it in an advancing train he sounds his *mi*, the other driver then sounds his *mi* if he is on the right line, then both sound *sol*.

Diffusion Between Moist and Dry Air through a Partition of Porous Earth.—M. Dufour.—Suppose two masses of air, at the same temperature, containing unequal quantities of aqueous vapour, on the opposite sides of a porous wall. An unequal diffusion occurs, and the more abundant current is from the drier to the moister air. Various modes of showing this are described. The change of pressure is not due to change of temperature, in fact the temperature varies in the opposite direction to that in which it should if this were the cause. The unequal diffusion depends essentially on the difference between the tensions of aqueous vapour on the two sides ; the increase and diminution of pressure are nearly proportional to this difference. Temperature influences the result only in an indirect way, causing greater or less differences of tension. M. Dufour thinks such apparatus as he describes might be utilised for determining the tension of vapour in free air.

Measurement of the Electromotive Force of Piles in Absolute Units.—M. Crova.—The author's method is as follows:—Let h, h', h'' be the interpolar resistances ; i, i', i'' the corresponding values of the intensity of the current produced by a determinate element ; instead of taking h and i as variables, trace the curve whose abscissæ are the values of i , and ordinates the corresponding values of $h i$. We shall obtain a straight line if the element is constant, and shall have (representing by y the values of $h i$), $h i = y = A - r i$, equation of a straight line, the ordinate of which, at origin, represents the electromotive force, and of which the angular coefficient is the resistance of the element. If we obtained by experiment n values of h corresponding to an equal number of values of i , we should have n points of the line sought, and if this is straight we can deduce from its construction the mean values of A and of r , which might be calculated by the formulæ of Ohm by means of $n-1$ couples of n consecutive observations grouped two and two. In fact, from errors of observation,

the n points of the line obtained will deviate very little in successive parts from an average straight line, which may be drawn without hesitation if the observations have been well made, and which will give the values sought of A and of r . This method has the further advantage of making known the limits between which the element may be considered as constant, and giving the value of variations beyond those limits. The author gives some examples of how the method applies.

Employment of Oxygen in a Balloon.—M. Fonvielle.—The example of Mr. Glaisher has shown that one may explore the atmosphere beyond 5000 metres without having recourse to oxygen.

Injection of Ammonia into the Veins to Counteract Injuries Produced by Viper Bites.—M. Oré.

Asphyxia through Insufficiency of Oxygen.—M. Le Blanc.

Functional Irritability on the Stamens of Berberis.—M. Heckel.—The author tried the effects of chloroform on the stamens. Introducing a drop every five minutes into a little capsule under the floral peduncle (the flower being under a receiver), the stamen movements were suspended on ten drops being given. From various experiments he concludes that functional irritability may be extinguished separately, and that although subordinated to nutritive irritability (the absolute characteristic of vitality) it is nevertheless independent of it, just as chlorophyllian respiration is independent of general respiration in plants.

Bulletin de la Societe Chimique de Paris, tome xxi., No. 4, February 20, 1874.

The Feculometer.—M. L. Bondonneau.—The author considers Bloch's feculometer a valuable instrument for the examination of farinas containing a large amount of impurities, but disputes its utility in cases where the foreign matters do not exceed 3 per cent. The most common causes of the alteration or sophistication of commercial farinas are fermentation, desiccation at too high a temperature, the presence of fragments of cellulose and of sand, and adulteration with the powdered pulp of potatoes. In the two former cases the error is trifling, and rarely reaches 1 per cent. In the two latter the difference between the real value and that shown by the feculometer may amount to 3 per cent without any indication that the sample is adulterated. The following test should, therefore, be superadded:—4 or 5 grms. of the sample are well stirred up with 100 c.c. of water, and 3 or 4 c.c. of a concentrated solution of caustic soda are added. The farina dissolves, and the foreign matters remain suspended. If the farina is pure it yields a colourless translucent matter, but if impure the colour is more or less yellow. Hydrochloric acid may then be added in large excess, when the paste becomes a thin liquid. The foreign matters subside to the bottom, and may be separated by decantation, and examined with the microscope.

On Dextrin.—M. L. Bondonneau.—The author finds that dextrin is transformed into glucose at high temperatures, in presence of an inert gas charged with moisture. The amount of glucose formed is greater the more acid the fecula employed.

Oxalurate of Ethyl, and the Cyanurate of Oxamethan.—M. E. Grimaux.—This paper is not adapted for abstraction.

Compounds of Glucinium.—M. Al. Atterberg.—A detailed account of the composition and properties of a number of glucinic salts.

Researches on Tribromacetic Acid.—M. H. Gal.—A notice of this paper has already appeared.

Reclamations respecting the Papers by M. Henri-vaux on the Insolation and the Devitrification of Glass.—M. Bontemps.—The author maintains the novelty of certain observations made by Gaffield, of Boston.

Researches on Essence of Alan-gilan.—M. H. Gall.—An account of the composition and properties of the essential oil of *Anona odoratissima*.

Determination of Tannin, Gallic Acid, and Pyrogalllic Acid.—M. M. Prud'homme.—Prepare a solution of methyl green in powder, 2 grms. per litre of water. The solution of tannin is 20 grms. per litre. The standard test-liquor employed is a solution of commercial chloride of lime at 8°, diluted with 10 to 15 times its bulk of water. One-fourth of a litre of water and 10 c.c. of the tannin solution are placed in a test-glass. Chloride of lime is dropped in from a burette, constantly stirring. When the liquid has become an orange-yellow a known volume of the green solution is added. The mixture becomes a dirty green, but on continuing to add the chloride of lime drop by drop a decided yellow colour is produced without a shade of green. The amount of chloride of lime corresponding to the measure of the green employed—which is determined by a previous experiment—is subtracted from the number read off on the burette, the remainder corresponds to the tannin. The same trial is made for comparison with pure tannin. Gallic acid presents nearly the same changes of colouration as tannin. Pyrogalllic acid is turned immediately yellow by bleaching-liquor. To determine the value of commercial tannin we begin by finding the quantity of pure tannin necessary for precipitating as completely as possible a solution of methyl green. A set of tannin solutions are prepared, increasing each by 1 gm. They are used to precipitate equal volumes of one and the same solution of green. The lakes thus obtained are filtered, and a known volume of each filtrate is treated with chloride of lime till decolourised. We obtain thus, for chlorine, a series of decreasing numbers, as the colouring-matter which remains in the filtrates diminishes progressively. But the moment the tannin is in excess the numbers begin to increase, the variation being more rapid than that of the decreasing series. This preliminary determination having been effected, then, to make the assay of a commercial tannin, we precipitate a solution of methyl green with a quantity of tannin, less in weight than the pure tannin just determined. We filter the lake and treat a known volume of the filtrate with chloride of lime. We obtain thus a number representing the foreign organic matters, that is to say, approximately a quantity of pure tannin of equal weight. If, on the other hand, we take a quantity of tannin equal in weight with that required to precipitate the green, and find the total amount of chlorine which it requires, the difference of the two numbers represents the pure tannin contained in the sample in question. To determine the chlorine corresponding to the unprecipitated green in the filtrate, a solution of green of the same strength may be made up with the colorimeter.

Isomerism of Terebenthene and Terebene from a Physical Point of View.—M. J. Ribau.—Terebenthene and terebene, though widely differing from a chemical point of view, agree closely in their physical properties except in their rotatory power, which is considerable in terebenthene, and *nil* in terebene.

New Reagent for Peroxide of Hydrogen.—M. Schöenn.—Calcined titanous acid is dissolved in boiling sulphuric acid, and the solution poured into a large quantity of pure water. Hydrated titanous acid is thrown down, which may be easily re-dissolved in dilute sulphuric acid. This solution is coloured orange or yellow by the peroxide of hydrogen.

Moniteur Scientifique, du Dr. Quesneville,
March, 1874.

The Chemical Products shown at the Vienna Exhibition.—M. E. Kopp.—This report, translated from the German, contains a list of the members of the various juries in the Chemical Department, among whom we find only one Englishman, the late Dr. Calvert. The production of sulphuric acid in Germany has risen, during the

last six years, from 1,130,000 quintals (of 50 kilos.) to 1,690,000. The valuable deposits of pyrites found in Switzerland (Valais) are mentioned as gradually coming into use. Galena and zinc-blende are now used in the production of sulphuric acid, in addition to copper and iron pyrites. Hasenclever and Helbig have constructed a kiln by the aid of which 80 per cent of the sulphur contained in blende may be utilised. This kiln consists mainly of a roasting-furnace and a kind of muffle, the sole of which forms an angle of 42° with the horizon. The blend is roasted with the aid of fuel. The gases derived from the combustion pass across the roasting-furnace, sweep round the muffle, pass under the plates which form the sole of the inclined plane, and from there into the chimney. The ores slide down the muffle, which forms an angle of 33° .

Products of the Transformation of Starch.—C. O'Sullivan.—This paper, the origin of which is not stated, does not admit of useful abstraction.

Use of Soap in Textile Manufactures.—Dr. H. Vohl.—All attempts hitherto made to replace soap by alkalies, alkaline carbonates, ammonia and its compounds, have proved unsuccessful. In textile manufactures, two classes of soaps are employed—the neutral and the alkaline, the latter containing an excess of alkali—caustic, carbonated, or in both states. The neutral soaps used in the textile trades are chiefly curd-soaps, made of soda and olive oil. They are employed principally in "ungumming" and preparing silk. According to Mulder, 100 parts of raw silk contain:—

Fibroin	53.37
Gelatin	20.66
Albumen (?)	24.43
Wax	1.39
Fatty and resinous bodies..	0.10
Colouring matter.. ..	0.05
	100.00

Subsequently Cramer showed that Mulder's albumen was a nondescript nitrogenous matter, soluble in acetic acid. The pure matter of silk, fibroin, ranges from 50 to 60 per cent. According to Staedler, a certain quantity of the mucilage (Mulder's albumen) is necessary for the silk, and, if it be entirely removed, the fibre becomes hard and brittle. Guinon and Sobrero show that raw silk may also contain mineral matters (lime, magnesia, alumina, and oxide of iron) which are injurious in ungumming and working the silk. Fibroin forms the nucleus of the thread, whilst the other substances form an outer covering. The latter substances are all soluble in soda, potash, and alkaline oleates—soaps. Fibroin, on the other hand, is insoluble in neutral solvents and acetic acid. Alkalies and alkaline solutions, and the strong mineral acids dissolve it with decomposition. Very dilute potash and soda lyes do not immediately dissolve fibroin, but even the smallest quantity of a free alkali robs the silk of its lustre, and reduces it almost to a paste. The only solvent which removes the superficial coating without injuring the fibroin is a neutral lye of soap. The nature of the fatty acid present in soaps used in the silk manufacture is unimportant, provided the alkali be thoroughly neutralised. It must, however, be remembered that different oils are capable of saturating different weights of alkali. To determine the amount of free alkali, we dissolve in a retort 20 to 25 grms. of the soap in distilled water, and add to the solution chloride of sodium, finely powdered and chemically pure, as long as a precipitate of soap is formed. The lye is then separated, and the precipitate is repeatedly washed with pure salt-water. All the liquids are then mixed, and if they show an alkaline reaction with test-paper—indicating the presence of free alkali or of an alkaline carbonate—the mixture is treated with carbonic acid, boiled, evaporated down to dryness, or to a very small volume, and the carbonic acid is determined directly in a Fresenius and Will's apparatus. If the amount of

carbonic acid thus found is the same as that determined in the soap, we know that the latter contains an excess of an alkaline carbonate, the quantity of which is indicated by the carbonic acid found. If the results of the two determinations differ, and if the soap directly gives less carbonic acid than the saline solution, it contains, then, besides the carbonate, free alkali, the amount of which is shown by the difference of carbonic acid in the two cases. If the soap assayed directly yields no carbonic acid, but the saline solution does, then there is in the soap merely free alkali, the amount of which appears from the carbonic acid found. If carbonic acid is found in neither case, the soap is neutral. This method is applicable to soft-soaps, chloride of potassium being added instead of chloride of sodium. According to Calvert, a soap for ungumming silk should contain—

Fatty acids	61.9
Soda.. .. .	8.1
Water	30.0
	100.0

Or in the anhydrous soap—

Fatty acid	88.438
Soda	11.562
	100.000

or 13.074 parts of soda to 100 parts of fatty acid. The quantity of soda thus indicated in a soap for silk-boiling, is too high if olive oil be employed. If cocoa-nut oil be used, 15.12 of soda are required for 100 of cocosic acid. A good dry Marseilles soap fit for silk-boiling contains, on an average, 88.469 of fatty acid and 11.531 of combined soda. According to Unger, 100 parts of cocoa-nut oil require for saponification 13.36 parts of soda. Bolley suggests the use of borax in place of soap. Silks containing lime and magnesia have to be treated with very dilute hydrochloric acid, then to be washed in soft water, and lastly boiled with soap. Silk loses, on an average, 25 per cent in boiling, but in some cases the waste may reach 38 or 40 per cent.

On Glycerin.—Fr. Nitsche.—An account of the industrial applications of this substance.

New Procedure for Rendering Beer Unalterable.—M. L. Pasteur.—This paper has been already noticed.

Manufacture and Refinery of Sugar.—M. P. Lagrange.—This long and valuable paper is not suitable for abstraction.

April, 1874.

Reduction of Ferric Chloride to Ferrous Chloride in the Quantitative Analysis of Iron Ores.—M. Ad. Kopp.—The ordinary method of reducing ferric chloride, by means of zinc alone, is tedious and requires a large quantity of zinc. The process is greatly facilitated by the addition of a little chloride of tin (stannous chloride). The method is as follows:—A few drops of a solution of the protochloride of tin are added to the ferric solution, which must be previously heated; its yellow colour then becomes paler, without disappearing entirely. A few fragments of zinc are then added, and the solution is heated in the water-bath till perfectly colourless, which may require three-quarters of an hour. It is then filtered through a filter in the bottom of which a few pieces of zinc are placed for security; the filter is washed with water which has been boiled, and the liquid is titrated with permanganate in the ordinary manner. Care must be taken not to add too much chloride of tin. With zinc alone, the reduction requires twenty-four hours.

Critical Studies on the Composition of Chloride of Lime.—E. Richlers and S. Junker.—A lengthy paper, not adapted for abstraction.

Composition for the Destruction of Bugs and their Eggs, Fleas, &c.—M. Doré.—This mixture, which has been patented in France, consists of 80 parts of bisulphide of carbon and 20 parts of essence of petroleum.

Lutecine, or Paris Metal.—MM. Le Mat, Picard, and Bloch.—

Copper	..	..	..	..	800
Nickel	..	..	..	..	160
Tin	..	..	..	..	20
Cobalt	..	..	..	..	10
Iron	..	..	..	..	5
Zinc	..	..	..	..	5
<hr/>					
1000					

A variety of other "receipts and formulæ" are given, which are not novel.

Reimann's Farber Zeitung, No. 10, 1874.

This number contains receipts for a scarlet on wool and cotton garments, and a dark green on the same material; a chocolate on woollens; a yellow and a claret on silks.

Coloured "Easter Eggs."—Strange as it may sound, dyeing eggs at Easter is now an important business in France. Let no one, however, ridicule this custom, for it first led to the use of albumen as a mordant.

The paper on washing plushes is continued.

There are receipts for dyeing six shades of grey on cotton; for a fast reseda on wool; a medium-brown, a dark and a light blue on alpacas; and a black on Thibet cloths and stockings. We have also a receipt for a vat-blue with a red, brown, black, and white pattern on cotton goods.

The editor gives next a receipt for cleaning kid gloves with benzin, which in this country is no novelty.

Chrome Mordant.—Wiz recommends the following mixture for printing chrome colours upon calico:—Put in a stoneware pan, holding 30 litres, 3 kilos. of chromate of potash, 4.4 litres of boiling water, and 2.6 of nitric acid at 36° B. This is done in the open air. The mixture is continually stirred with a glass rod, and 0.72 litre of white glycerin at 28° B., and 4.28 litres of acetic acid at 7° B., are gradually introduced. When the chromate is quite dissolved, and the frothing is over, it is poured into a copper colour-pan, and kept at a boil for a few minutes, till it has become a fine green. It is returned to the stoneware vessel, and allowed to stand overnight. The nitrate of potash which separates out is removed, and washed with 0.8 litre of cold water, and the washings are added to the mordant. The yield is 10 litres of mordant at 30° B., consisting of a mixture of nitrate and acetate of chromic oxide. It does not become turbid on dilution, and can be thickened easily. It neither decomposes starch-paste, nor coagulates gum-water. This mixture alone yields a good *vert Havraneck*; with logwood, a black and a grey; with quercitron, an olive; with berry-liquor, an orange; with catechu, a brown; with artificial alizarin, an amaranth; and with extract of madder, a claret.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in compositions for preserving meat, vegetables, fruit, and other articles of food. William Juby Coleman, Blackheath, Kent. July 30, 1873.—No. 2585. According to this Provisional Specification, a mixture of sulphurous acid, bisulphite of lime, bisulphite of potash, bisulphite of soda, and sugar is employed.

Improvements in the manufacture of manure. John Leigh, Manchester. August 6, 1873.—No. 2638. It is proposed to manufacture manure from human excreta, that is, from urine and feces collected in suitable vessels or receptacles, by adding thereto fine ashes produced by the combustion of coal, street-dust, and other refuse matters, and also sulphate or muriate of lime, the latter being added to fix the ammonia contained in the excrement treated, or generated during the decomposition of the said excrement. The proportion of sulphate or muriate of lime used is about 120 lbs. to each ton of the solid material used.

Improvements in preserving meat and other articles of food. James George Petrie, Tottenham Road, Southgate Road, Middlesex. August 8, 1873.—No. 2658. This Provisional Specification describes dipping the meat in a solution of the following substances:—Bisulphite of lime, bisulphite of soda, bisulphite of alumina, and sugar.

Improvements in treating putrescent or putrescible matters, such as sewage, night-soil, fish, offal, blood, and other animal matters and vegetable matters, for the manufacture of manure therefrom. Christo-

pher Rawson, general manager to the Native Guano Company (Limited), Saint Swithin's Lane, London, William Cameron Sillar, Blackheath, Kent, John William Slater, analytical chemist, Tamworth Terrace, Middlesex, and Thomas Sipling Wilson, engineer, Cambridge Terrace, Surrey. August 8, 1873.—No. 2662. This invention consists in making manure from sewage and night-soil, and from fish, offal, blood, and other animal matters, and from vegetable matters, by forcing through the said matters sulphurous acid gas, chlorine, hydrochloric acid gas, carbonic acid gas, nitric, nitrous, or hyponitric vapours, fumes, or gases, carbolic acid vapour, and cresylic acid vapour, or any other volatile antiseptic derived from coal-tar or petroleum. This invention further consists in mixing with animal matters the sulphite and bisulphite of lime, and sulphite and bisulphite of magnesia, the sulphates of alumina, common alum, and the sulphites and chlorides of iron or of manganese, either in lieu of, or in addition to, the treatment with the aforesaid gases. Also in mixing with night-soil bisulphite of lime and bisulphite of magnesia, either in lieu of, or in addition to, the treatment with the gases hereinbefore referred to. The matters after being thus treated are dried and powdered.

Improvements in the purification of gas, and in the extraction of residual products therefrom. Augustus George Vernon Harcourt, Christ Church, Oxford, and Frederick William Fison, Ilkley, York. August 13, 1873.—No. 2685. The objects of this invention are—First, to purify illuminating gas from sulphuretted hydrogen and from ammonia by the application of a mixture of materials which may be dealt with as one substance and used to remove both these impurities without necessitating the employment of separate purifiers or the arrangement of different materials in separate layers; secondly, to dispense with washing or scrubbing; thirdly, to use the same quantity of oxide for any length of time; and, fourthly, to obtain sulphur and sulphate of ammonia economically. To purify gas from sulphuretted hydrogen we employ hydrated peroxide of iron (hereinafter termed oxide), and to purify it from ammonia we employ a solution of persulphate of iron. The invention may be applied at once to any of the kinds of oxide now used. The solution of persulphate of iron we prepare from time to time by dissolving a part of the oxide in dilute sulphuric acid. To apply this liquid to the removal of ammonia we sprinkle it over the oxide during revivification and before the oxide is replaced in the purifier. Thus the purifier is charged with a mixture of oxide and persulphate of iron, each of which acts independently. The oxide absorbs sulphuretted hydrogen, forming sulphide of iron, water, and sulphur; the last-named substance (formed also during revivification) accumulates, and, after a certain proportion has been reached, must be removed as fast as it is formed. The persulphate of iron absorbs ammonia, forming sulphate of ammonia and oxide. The sulphate of ammonia also accumulates as the process goes on, and must be kept down by the extraction of portions from time to time. The amount of oxide in use remains constant, since all that is removed for conversion into persulphate of iron is restored by the addition of the persulphate of iron thus formed to the contents of the purifier, and its re-conversion into oxide by the action of ammonia. The treatment of a part of the purifying material taken out of the bulk of that exposed for revivification in order to remove and obtain from it sulphur and sulphate of ammonia and to obtain persulphate of iron, which in turn arrests ammonia and is re-converted into oxide, is the distinctive feature of our invention. The process by which this is effected consists in extracting the material, first with water, which dissolves out the sulphate of ammonia, and next with dilute sulphuric acid, which dissolves the oxide, forming a solution of persulphate of iron. The undissolved residue consists of sulphur. By evaporating the solution of sulphate of ammonia, and by washing and drying the residue of sulphur, these substances are obtained at once in a saleable form. We propose further, as a desirable, but not indispensable, addition to the processes already described, to convert the ammonia and ammoniacal salts of the liquor from the condensers into sulphate of ammonia (reuniting this portion with the rest of the ammonia formed in the retorts), by heating the liquor, by itself or mixed with lime, in a vessel through which a current of gas passes to the purifiers.

NOTES AND QUERIES.

Valuation of Salt-Cake.—(Reply to "J. O.")—If the effect of ignition of salt-cake with addition of ammonia was simply the expulsion of a quantity of H_2SO_4 equivalent to the free HCl present, it would of course be easy to deduce thereby the amount of free HCl. But the result is much more complex, there being present not only free HCl and H_2SO_4 , but also NaCl, Na_2SO_4 , H_2O , &c., all of which are more or less decomposed or volatilised by the ignition. Thus "J. O." will see that the method in question would not answer, even if his obvious suggestion be adopted.—WALTER TATE.

TO CORRESPONDENTS.

ERRATUM.—Page 227, col. 2, line 15 from top, for "Dr. Hill" read "D. Hill."

A Student.—It looks like fibrous hæmatite.

BOOKS RECEIVED.

Annual Record of Science and Industry for 1873. Edited by Spencer F. Baird. New York: Harper Bros. London: Trübner and Co.
The Journal of the Iron and Steel Institute. Vol. I., 1873. E. and F. N. Spon.
Report upon the Sanitary Condition of the Districts of the Combined Sanitary Authorities of Oxfordshire; Ladyday, 1873, to Ladyday, 1874. By Gilbert W. Child. Longmans and Co.

MEETINGS FOR THE WEEK.

MONDAY, June 1.—Royal Geographical, 1 p.m. Anniversary.

TUESDAY, 2.—Anthropological Inst., 8.
Zoological, 8.30.

WEDNESDAY, 3.—Microscopical, 8.

THURSDAY, 4.—Royal Society Club, 6.

Chemical, 8. Huskisson Adrian, "On Dendritic Spots." James Resch, "On the Acidity of Normal Urine." J. W. Russell and S. W. West, "On a Simple Form of Apparatus for Estimating Urea in Urine." M. M. Pattison Muir, "Note on Kauri Gum." George S. Johnstone, "On Certain Compounds of Albumen with Acids." E. Neison and James Bayne, "On Ipomæic Acid." Watson Smith, "On the Action of Chlorine, Bromine, &c., on Iso-Dinaphthyl." Dr. Tommasi, "On Acetyl Sulphite." Dr. Tommasi, "On a New Product of Toluol."

FRIDAY, 5.—Royal Institution, 8.

Geologists' Association, 8.

Chemical Technology, or Chemistry in its Applications to the Arts and Manufactures. By THOMAS RICHARDSON and HENRY WATTS. Second Edition, illustrated with numerous Wood Engravings.

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THE CHEMICAL NEWS.

VOL. XXIX. No. 758.

ON THE VOLUMETRIC DETERMINATION OF CARBONIC ACID

BY A

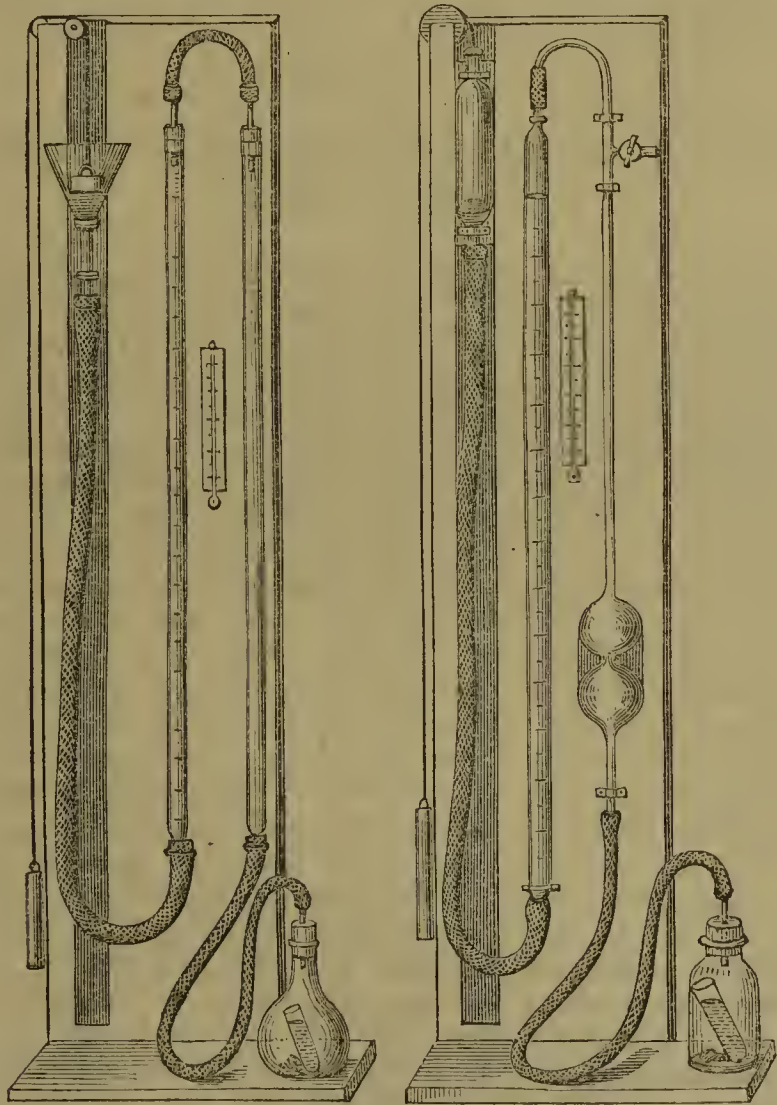
MODIFICATION OF SCHIEBLER'S APPARATUS.

By EDWARD NICHOLSON,
Army Medical Department.

IN the course of some experiments on limestones, limes, and cements, I had great need of an apparatus which would enable fairly accurate determinations of carbonic acid to be made with rapidity. I considered it useless to import a Schiebler's apparatus if the india-rubber bladder which forms part of it was essential, for even thick india-rubber tubing loses its elasticity after a few months in India, and very thin india-rubber would probably arrive in a glutinous condition. I therefore tried setting up a modified form of the apparatus with the limited stock of materials at hand, and dispensing with the india-rubber bladder. The results have been so successful that I think the simple apparatus I made might be the basis of a less complicated apparatus than that devised by Dr. Schiebler. I append a sketch showing in Fig. 1 the actual apparatus I set up, in Fig. 2 that which I would recommend for use in countries where the manufacture of apparatus is carried on.

FIG. 1.

FIG. 2.



It will be seen that, for the second graduated tube of Schiebler's apparatus, with its outlet-pipe, reservoir-bottle, and blowing-tube, I substitute a reservoir which can be lowered as the pressure of gas forces down the column of water in the graduated tube. I dispense with the diaphragm formed by the india-rubber bladder, relying on the impossibility of diffusion taking place beyond the double bulb during the short time which the operation requires. If the graduated tube be of 130 c.c., a quantity of gas

equivalent to 0.5 gm. of calcium carbonate will not be beyond its capacity, at least in most European laboratories. The reservoir should be able to contain, within its perfectly cylindrical part, somewhat more than the quantity of water for which the tube is graduated.

To set the apparatus in working order, raise the reservoir (by means of the cord and counterpoise) until its lower end is $\frac{1}{2}$ inch or 1 inch below the zero of the graduated tube, and then pour in distilled water until the column rises to that point. Note the lower level of the water in the reservoir, consequent on the smaller calibre of the graduated tube; this difference for capillarity should be maintained at all readings of the column of water. When the column is under pressure, as at the end of an operation; the difference can, if necessary, be accurately adjusted by means of a scale corresponding to that of the graduated tube, and marked on the frame, or by a sliding pointer; but this is really unnecessary, for the allowance can be made with sufficient accuracy by the eye. Considering that the height of the column is only affected by less than one-tenth of the amount of error in the adjustment of the reservoir-level, the possible error in an adjustment by the eye is trivial. An error of a whole centimetre of height in the adjustment would affect the reading to the extent of 0.06 c.c. only. Even with a reservoir of varying calibre, as in the case of the funnel used in the rather rude apparatus I set up, the greatest possible error arising from defective adjustment for capillarity is well within 0.1 c.c.

Mode of Operating.—Into the flask or bottle used for the reaction, a weighed quantity of powdered carbonate is introduced, together with a glass or gutta-percha tube containing either 5 c.c. or 10 c.c. of diluted hydrochloric acid. The flask being connected with the apparatus, adjust the level of the water to zero, and then close the air-cock at the top of the bulb-tube. Holding the flask by the neck with the right hand, allow the acid to flow on to the carbonate, while the left hand, on the cord of the counterpoise, lowers the reservoir as the gas forces the water down in the graduated tube. Agitate the flask as the action slackens, and when the column remains fixed, read off the height, the level of the reservoir being adjusted for capillarity. The operation being finished, disconnect the flask; raise the reservoir in order to drive carbonic dioxide out of the apparatus, and then open the air-cock; it may be left open until the next operation. In the apparatus shown in Fig. 1, there is no air-cock, and the level of the water-column being depressed by the act of closing the flask cannot be brought to zero; I therefore lower the reservoir to the proper level, read off the height of the column, and deduct the number from that found after the operation.

The sources of possible error in determination by this apparatus are—

1. From expansion of the gas disengaged, in consequence of the heat produced during reaction.
2. From the absorption, or rather retention, of gas by the acid used for decomposition of the carbonate.

The first appears to be quite unimportant, except when the substance operated on contains much free base, as in the case of a partially carbonated lime; when operating on such a substance, the flask should be immersed in *air-warm* water during the reaction. The second error can be ascertained and allowed for. Dr. Schiebler sets it down at 0.8 c.c. for 10 c.c. of acid, sp. gr. 1.12. I think it better for each operator to ascertain the error for the acid he uses; let him make two sets of experiments with the same quantities of calcium carbonate, decomposing this in one set by 5 c.c., in the other by 10 c.c., of acid. I find that 1 c.c. for 5 c.c. of dilute acid (diluted with its bulk of water) is a good allowance; it is, if anything, slightly under the mark.

The volume of gas obtained being corrected for absorption, the result may be calculated in two ways, as when the original apparatus is used—Either the experiment may be succeeded by a standard experiment on the same

nature, the results obtained are not the less valuable for science, which may gladly record them, without becoming bound by the theoretical ideas with which they are associated. Without insisting, therefore, on those ideas, without following the authors in a not very happy calculation of the heat liberated by coercion of the water during solution, we proceed to expound some of the results of this long series of researches—results on which the reader may put his own interpretation.

I. *Law of Modules—Thermo-Neutrality.*—If a large number of saline solutions are compared together, the thermal effect due to each of the saline radicals is always the same, independent of the second radical with which it is associated, and defined by a constant quantity, termed its *thermal module*. To this law, established by experiments that are now old, is referred the principle of the *thermo-neutrality* of salts; in virtue of which different salts, put successively in the same quantity of water, behave, from the thermal point of view (provided they do not give a solid precipitate), in the same way as if they were dissolved separately, the various saline radicals being in complete indifference to each other, so that one cannot say that one of the metalloidal radicals is associated with one of the metallic radicals rather than with another.

Formulated in 1840, by Hess, in terms almost the same, and verified by Graham, the principle of thermo-neutrality has received from the calorimetric studies of M. Favre a full confirmation, wherever the salts operated with have been salts with a strong acid.

Among the numerous experiments made by M. Favre on this subject, I will cite only the following, in which have been measured the quantities of heat liberated by the solution of 1 equivalent of a salt in a large quantity (230 equivalents) of pure water, or in the same quantity of water containing already 1 equivalent of another salt in solution:—

Sulphate of potassium	3357
„ ammonium	3279
„ copper	3329
„ ammonium and of copper	3377
„ potassium and of copper..	3432
„ sodium	3370
„ zinc	3324

Experiments based on quite another principle lead to the same conclusions. M. Favre has observed, in fact, that equal quantities of heat were liberated by the precipitation of 1 equivalent of sulphate of baryta, when chloride of barium dissolved was made to react on different neutral sulphates, simple or double, in extended solution. The results are contained in the following table:—

Salts Experimented on.	Quantity of Heat Liberated by Solution of the Salt.		Observations.
	In Pure Water.	In Water containing already in Solution the Equivalent of a Foreign Salt.	
Sulphate of sodium ..	-9335	-9454	The foreign salt, already in solution, was chloride of copper.
„ ammonium ..	-1009	-1018	
„ zinc	-2002	-1956	
„ sodium ..	-9335	-9213	
„ zinc	-2002	-1970	The foreign salt, acetate of zinc.
Chloride of potassium	-4574	-4390	
„ copper ..	-2194	-2411*	
Nitrate of potassium	-8185	-8013	The foreign salt, nitrate of potassium.
Chloride of copper ..	-2194	-2187	
Acetate of zinc	-1647	-1530	The foreign salt, sulphate of ammonium.

The thermo-neutrality of these solutions is a necessary inference.

II. *Densi-Neutrality.*—In studying the variations of volume which accompany the phenomenon of solution, M. Valson has observed that the densities of saline solutions satisfy relations of the same kind as the quantities of heat called into play. Suppose a series of normal saline

solutions; that is, containing 1 equivalent (in grammes) of anhydrous salt dissolved in 1 litre of water. If we pass from one saline solution to another, different from the first only by the metallic radical, experiment shows that there is a variation of density proper to the new metallic radical; which variation is constant, and independent of the common metalloidal radical. Similarly, if we pass from a given solution to another solution differing by the metalloidal radical, this difference involves a variation in the density proper to the new metalloidal radical and independent of the metallic radical. Thus there are modules of density (which are simply these variations), as there are thermal modules, the radicals always preserving, in some sort, their personality; and there is a neutrality with reference to densities as there is with reference to heat. The principle of densi-neutrality permits, moreover, of the same restrictions as the principle of thermo-neutrality, restrictions to which we shall return later.

M. Valson has even extended the relation of neutrality to still other actions; he has shown that capillary actions also satisfy the law of modules, and that consequently they are of the same order as the preceding.

III. *Special Study of Alums.*—The alums have specially attracted the attention of MM. Favre and Valson, who have studied them as types of double salts, as regards both the thermal phenomena and the phenomena of contraction, which accompany solution.

According to the principle of thermo-neutrality, a double salt, soluble, no longer exists, in a solution sufficiently extended, in the state of a double salt. This has been ascertained by the authors, in the case of alums, by the double experimental method they had already followed for verifying the principle of thermo-neutrality; they have, then, employed successively—(1) the solution of a salt in water containing already another salt dissolved; (2) the precipitation, by chloride of barium, of the acid of the double salt in extended solution.

They have thus observed the destruction of alums by water, and they have seen, added to this, the dissociation, likewise by water (and even to an advanced degree), of the sulphate of sesquioxide of iron, which entered into the composition of two of the alums experimented with.

Thus, according to the calorimetric experiments, water seems to limit itself, in the case of alums in general, to dissociate the two constituent salts; whereas, with alums of iron, it appears to dissociate also the elements of sulphate of sesquioxide of iron, even to such a point that, according to the experiments of precipitation by chloride of barium, the sesquioxide remains in solution in presence of an acid which has ceased to exert upon it its ordinary chemical action. Is there not something here related to the curious modifications of sesquioxide of iron studied by Graham and M. Debray?

The study of phenomena of contraction, which accompany the solution of alums, shows that the principle of densi-neutrality is true for these salts, like the principle of thermo-neutrality.

There are, in fact, modules of density for the constituent radicals of these salts; that is to say, that each metal has a proper action on the density of the normal solution, independent of actions of the same order exerted by the other radicals present.

We may add that there are also, in the case of alums, capillary modules, which the authors have carefully determined.

The whole of these determinations prove that alums (and double salts in general) cannot subsist in presence of water, but that they are decomposed into their constituent salts. Indeed, we always find the same numbers for the density or the capillary height of solutions of alums, as for the quantity of heat called into play in solution; whether they are determined directly through the experiment of dissolving the alums, or calculated from numbers furnished by the solution of each of their constituent salts.

IV. *Exceptions to the Laws of Neutrality.*—The foregoing researches show that thermo-neutrality and densi-

* A slight precipitate is formed.

neutrality are correlative properties of neutral saline solutions; when there is thermo-neutrality there is also densi-neutrality, and *vice versa*.

The experiments of which we have now to speak have shown that, when one of the properties disappears, the other disappears also.

M. Berthelot has some beautiful researches on salts which form an exception to the principle of thermo-neutrality, and important consequences are deduced relative to the comparative action of *strong* acids and of *weak* acids. These denominations have now been considerably advanced in precision; the preference of certain acids for certain bases has been distinctly affirmed and justified. We shall not insist further on this side of the question; and, putting aside the acid salts which the researches of M. Thomsen have classed among the exceptions, we shall merely consider the phenomena of contraction presented by certain double salts, selecting, as our authors have done, salts already studied by M. Berthelot.

If we dissolve 1 equivalent of carbonate of soda in 1 litre of water containing already, in solution, 1 equivalent of sulphate of ammonium, the mixture presents an exception, with reference to thermo-neutrality, which is explained, as M. Berthelot has shown, by supposing an exchange almost complete between the acids and the bases.

The study of densities leads to the same consequences; the agreement between observation and calculation being re-established only if we take for calculation of averages, not the original salts, but salts (carbonate of ammonium and sulphate of sodium) resulting from their double decomposition. The conclusions are the same with borate of sodium and sulphate of ammonium.

In a general manner, the salts with strong acids alone satisfy the double relation of neutrality.

In citing these results, which have particularly struck us in the work of MM. Favre and Valson, our object has been, not so much to call the reader's attention to the results themselves, as to show him, by some examples, what valuable deductions may be made from these researches.

NOTICES OF BOOKS.

Fifth Annual Report of the State Board of Health of Massachusetts. January, 1874. Boston: Wright and Potter.

A SUBSTANTIAL volume of 550 pages, abounding in matter interesting to all sanitary authorities and medical practitioners. The work comprises the "General Report" of the Board: the Financial Report; a paper on "Preventive Medicine, and the Physician of the Future;" a report on the present condition of certain rivers in Massachusetts, together with considerations touching the water supply of towns; the "Brighton Abattoir;" Report on the Health of the Farmers of Massachusetts; Cerebro-Spinal Meningitis in Massachusetts in 1873; Hospitals; Political Economy of Health; School Hygiene; the Work of Local Boards of Health; the Use of Galvanised Iron for the Storage and Conveyance of Drinking-Water; the Health of Towns.

Most of these papers are, of course, medical, rather than chemical, in their nature. We do not find any novel suggestion as to the best method of dealing with sewage, though the admission of such refuse into rivers is strongly condemned, and the deterioration of the streams and lakes from which the towns of Massachusetts derive their water supply is pointed out as a growing evil. There appears even reason to anticipate that, without active measures are adopted, Lake Cochituate, from which the Boston water-works are fed, may become polluted.

The analytical method used in determining the nitro-

genous impurities in water is that of Wanklyn, Chapman, and Smith, which is justly pronounced "the best and most available means at present at our command." The oxygen held in solution in the waters has been determined with a standard solution of hydrosulphite of soda, as proposed by Schützenberger and Risler.

As regards the use of galvanised iron for water-pipes and cisterns, there appears to be decisive evidence that the zinc is attacked, and, to a small extent, dissolved. We should not, however, feel free to endorse the opinion that "the contained zinc-salts in solution do not exert any deleterious effects upon the human system."

It seems to us that the public in the United States take a lively interest in sanitary matters, and that the Reports of their Boards of Health, whether for entire States or for single cities, are more accessible and more widely circulated than are documents of a corresponding character in England.

Medical and Pharmaceutical Notes. By E. R. SQUIBB, M.D. Philadelphia: Sherman and Co.

THIS pamphlet includes papers on the Preservation of Hypodermic Solutions; on Ergot and its Preparations; on Rhubarb; on Physicians' Pocket-Cases; on Buying Alcohol and Distilled Spirits; and on a General Apparatus Stand, Upright Condenser, Pinchcock, and Burette Stand.

We very much approve of the author's proposal that alcohol should be sold exclusively by weight, and that in all transactions its strength should be expressed, not by reference to the excise "proof," but simply by the weight percentage of absolute alcohol present.

Dr. Squibb's apparatus-stand seems likely to be useful, but we could not make its construction intelligible to our readers without the use of illustrations.

Bulletin of the Bussey Institution. Cambridge (U.S.): Welch, Bigelow, and Co.

THE "Bussey Institution" is a foundation in connection with Harvard University, having for its object agricultural experiments and investigations, and the "diffusion of sound agricultural principles and methods." The "Bulletin" before us is the first yearly issue of its transactions.

Professor Storer calls attention to the very low character, and relatively high price, of the superphosphates used in the State of Massachusetts, many of which contain not above 5 per cent of soluble phosphoric acid, and are sold at double their calculated agricultural value.

The Bussey Institution will, doubtless, do good service to agriculture, and we wish it a prosperous career and full appreciation.

The Gas Managers' Handbook. Consisting of Tables, Rules, and useful information for Gas Engineers, &c. By T. NEWBIGGING. Second Edition. London: W. B. KING.

THIS work has been filled with promiscuous matter under high pressure. The type is small, the margins narrow, and the language remarkably concise. We find here information mechanical, chemical, commercial, legal, and historical. We find formulæ for coloured fires, devices for illuminations, varnishes, cements, lacquers, arithmetical tables (some of which, as cloth measure and yard measure, have no very direct bearing on the subject in hand), prices of materials, hints on chemical nomenclature, and it is hard to say what. Even the value of manures has not been overlooked, gas liquor obtaining the post of honour, on the faith of certain results obtained by a Mr. Wilson, of Largs. Had this experiment been carried on, season after season, the consequence would soon have appeared as utter sterility. Neither ammonia, nor phosphates, nor potash, nor any one of the elements of vegetable life, can alone maintain the fertility of a plot of land under cultivation. Whatever substance, in a desultory

experiment, happens to be wanting to a plot of land will, if applied as a manure, produce astonishing results; whilst on another plot, where the soil is in a different condition, it may be nearly useless.

We find another curious passage bearing upon agriculture:—"Gas-pipes laid through arable land do it no harm, but rather good, inasmuch as they help to drain the land. The joints should be carefully made, as the escape of gas is fatal to vegetable life." As the joints are rarely, if ever, absolutely air-tight, we fear that the benefit to the land must be infinitesimal.

The bulk of the information here offered is, however, accurate as far as it comes within our cognisance, and we have no doubt that gas managers will find it a very useful companion. One thought which this book suggested to us we deem it right not to suppress. The gas manufacture is essentially a chemical art. The original decomposition of the coal, the purification of the gas, the separation and utilisation of the by-products are all chemical processes. Mechanical operations play a very subsidiary part. Yet the conduct of this manufacture has fallen exclusively into the hands of engineers. The work before us is written by an Associate of the Institute of Civil Engineers. It is dedicated to the President of that body.

We will venture to say that, unless chemists follow the example of all other professions, and organise themselves, the encroachments made upon them by medical practitioners, by pharmacutists, and by engineers, will ultimately cut away the entire ground from under their feet.

Inklings of Areal Autometry; showing how Rectal, Curvilinear, and Mixed Planes may be Measured by their Constituent Parts with more Exactitude than by employing the Radii of Circles and Chords of Arcs. By WILLIAM HOULSTON. London: Simpkin, Marshall, and Co.

A SMALL book, with a long title and a useful object, but written, unfortunately, in a language not to be acquired on short notice. As a specimen, we quote the following:—"In a block-et-arc-amalgless a flux of 48 ams arises when composed of 48 amalgams (for 48 amalgs), along with 3 frag-quoins and a sub-germ; then 4 germs (for a semi-umbel) make it a capsule fluxed 48 ams; this, in turn, is taken from a capsule, and 4 circles of 4² each fluxed 12 ams, yields the 4 circles cleared off the flux." "A semi-circlet is a combination of a semi-mitre and biperiare, or a dualgerm and fan-cap." We fear the public, on reading such passages, will be apt to exclaim, with old Mistress Quickly: "By my troth, Captain, these are very bitter words." We may congratulate ourselves, however, that the author is a mathematician, and not a chemist, as in that case his new-coined terms would have contained far more syllables than they now do letters.

CORRESPONDENCE.

COMMERCIAL ANALYSES.

To the Editor of the Chemical News.

SIR,—With regard to Mr. Cook's letter, which appeared on the 8th inst., allow me to offer the following remarks:—It is a well-known fact that, after combining the amount of phosphoric and carbonic acids in bones, bone-ash, &c., with lime and magnesia, a certain proportion of lime remains over, which, according to Professor Heintz, is assumed to occur as calcic fluoride, and to amount in recent bones to about 3½ per cent.

In a pamphlet published in 1861, Dr. Voelcker showed that recent bones do not contain so large a proportion of calcic fluoride. With reference to the excess of lime, which he invariably found in his analyses of absolutely pure bones, as well as in commercial bone-ash and animal charcoal, he writes as follows:—"As lime and phosphoric

acid unite together in so many different proportions, and unite together in so many different proportions, and as many of these compounds are basic in their character, it is highly probable that bone-ash contains a more basic phosphate of lime than has hitherto been supposed to exist." At all events, it is a well-established fact that bones, bone-ash, and animal charcoal contain a considerable quantity of lime, which is neither combined as tri-basic phosphate, carbonate, nor fluoride of calcium.

The cause of this excess of lime has been enquired into lately in Germany, and interesting papers by F. Wibel and C. Aeby appeared in Nos. 4 and 7 of this year's *Berichte der Deutschen Chemischen Gesellschaft zu Berlin*. These gentlemen, though differing in their conclusions as regards the pre-existence of the more basic phosphate of lime in recent bones, both agree that such a basic phosphate exists in bone-ash and animal charcoal.

In 1861, Dr. Voelcker showed that the excess of lime in bone-ash does not occur as caustic lime, and cannot be converted into carbonate by treatment with ammoniac carbonate. Wibel has also made the same observation, and proved the interesting fact that, upon heating tricalcic phosphate and calcic carbonate together, a certain amount of lime of the latter enters into combination with the phosphate, and is not re-converted into carbonate by treatment with ammoniac carbonate. From 30 to 40 per cent of the total carbonic acid in the original substance becomes thus lost.

I trust these remarks will meet Mr. Cook's difficulty.—I am, &c.,

FREDK. JAS. LLOYD.

16, Barbara Street, Barnsbury, N.

THE EVIDENCE OF EXPERTS.

To the Editor of the Chemical News.

The letter of "Accuracy," in CHEMICAL NEWS, vol. xxix., p. 215, has led me to cite the following, which came under my own observation a few months ago:—

A person, calling himself a "professor of chemistry," and practising as consulting and analytical chemist in a manufacturing town in England, is engaged by the plaintiff in a trial by arbitration, where the verdict rests principally on chemical evidence. The following are two out of many equally correct statements made by this chemist at one of the sittings of the case. The statements were made distinctly by the chemist, and written down by the arbitrator as follows:—

First.—" (That iron pyrites is a sulphide of iron having more sulphur than a protosulphide), and that, when burned for the production of sulphuric acid, the excess of sulphur burns away and leaves protosulphide of iron." Here he was questioned as to whether it was not principally oxide of iron which was left, but, as an acknowledgment of this would have quashed a theory he previously advanced, he positively denied it.

Second.—He said "that vat waste, as generally produced, contained no trace of matters soluble in water, that it was entirely composed of sulphide of calcium, and that it was incapable of oxidation."

It would be well if the system of trafficking in chemical evidence could be abolished, and that "professors" of the above stamp should find that something stronger than their moral principles would compel them in any legal case to give their unbiassed opinions or none at all.—I am, &c.,

JUSTICE.

May 28, 1874.

SODA AND SEWAGE.

To the Editor of the Chemical News.

SIR,—I have read with much interest Mr. Vincent's paper on the manufacture of soda. I want to point out how, in my opinion, an additional profit may be yet incorporateⁿ

with Le Blanc's process, and another by-product made available. I have patented a process for the treatment of aluminous schist with sulphurous acid gas, air, and steam, and, by subsequent lixiviation, the production of a liquor containing the sulphates of aluminium, iron, and magnesium. Under another patent, I treat the liquor thus produced with chloride of sodium, and, by crystallisation, separate the sulphate of sodium formed. By using the proper proportion of sodium chloride, a concentrated solution will remain, containing the chlorides of aluminium, iron, and magnesium. This may be used for the purpose of sewage defæcation, or, as described in my patent, it may be first treated with a proportion of the original liquor sufficient to convert the magnesium chloride into sulphate, which may be crystallised out, and the concentrated solution of aluminium and iron chlorides used for sewage purposes. These results have been worked out by me at great expense, and I believe each step in the process to be practical and feasible, and that, if the process were applied, sulphate of sodium might be produced at a reduced cost, and an exceedingly cheap sewage material put into the market as a by-product.

I solicit the publication of these particulars in your columns, as I am exceedingly anxious to ascertain the views of practical men on the subject.—I am, &c.,

SIDNEY W. RICH.

CHEMICAL VACANCIES.

To the Editor of the Chemical News.

SIR,—Subscribers to the CHEMICAL NEWS must often have noticed in the advertisement page the large number of advertisements for situations in proportion to the number of chemists wanted. I do not know how others fare, but twice I have advertised for a situation, and on neither occasions got an answer. Is the supply of chemists in excess of the demand for them, or is there any other reason for the disproportion? Chemists, too, as a rule, do not advertise for situations on the principle that when a chemist is wanted he is advertised for.—I am, &c.,

A. Z.

May 25, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, April 6, 1874.

Experimental Researches on Bihydrated Sulphuric Acid.—Is. Pierre and Ed. Puchot.—If in a bath at 5° to 6° below 0° we place a flask fitted with a thermometer, and containing bihydrated sulphuric acid, it takes the temperature 7.5° , and deposits crystals more and more abundant. As long as the whole of the liquid is not solidified the temperature of the interior remains stationary, whilst the external temperature of the bath gradually rises. The temperature of the acid, $\text{SO}_3 \cdot 2\text{HO}$, remains for a long time at the same point, whilst that of the external liquid may exceed $+10^{\circ}$. If in a bath cooled below 0° the acid, $\text{SO}_3 \cdot 2\text{HO}$, assumes and preserves so long the temperature 7.5° , it is because in solidifying it disengages a sufficient quantity of latent heat which keeps the temperature at this point. The acid, $\text{SO}_3 \cdot 2\text{HO}$, is one of the bodies in which it is easiest to show the phenomena of surfusion. The authors have kept from 500 to 600 grms. at the temperature of melting ice without any trace of crystallisation. Even agitation was inoperative, but on dropping in a few fragments of the crystalline hydrate crystallisation at once set in. The crystalline form of $\text{SO}_3 \cdot 2\text{HO}$ is an oblique

rhomboidal prism. If sufficiently cooled common sulphuric acid diluted, but containing less than 2 equivalents of water, can be split up into the crystalline bihydrate, and into a more concentrated acid.

New Process for Determining the Alcohol in Wines.—M. Ducleaux.—If to a known volume of water larger and larger quantities of alcohol are added, the density and the superficial tension of the mixtures obtained are simultaneously diminished, and consequently there is an increase in the number of drops which they form if allowed to flow slowly from a given aperture. If this aperture has constant dimensions the number of drops corresponding to each alcoholic mixture is constant also. The difference between the numbers thus found is large enough to furnish a basis for a very sensitive alcoholometric method. The instrument proposed is a pipette holding 5 c.c. It is filled with the alcoholic liquid under examination, and the number of drops escaping is counted. From this number the proportion of alcohol is calculated by the aid of tables which the author has drawn up. Slight traces of liquids more diffusible than alcohol, such as acetic ether, greatly increase the number of drops.

Density of Hydrogen Combined with Metals.—L. Troost and P. Hautefeuille.—The definite compounds formed by hydrogen with palladium, potassium, and sodium have many characters in common. All are obtained by the direct action of their elements. Hydrogen unites with palladium at 100° , with potassium above 200° , and with sodium at higher temperatures. The compounds formed are stable at common temperatures. Their formulæ are Pd_2H , K_2H , Na_2H . If hydrogen gas is allowed to act upon these definite compounds the absorption is very slight in the sodium compound, greater in the potassium, and considerable in the palladium. This absorption yields no new compounds, it is a mere condensation of the gas. The authors calculate the specific gravity of the condensed hydrogen at 0.629.

Experiments on Combustion in the Animal Organism.—P. Schützenberger.—The author concludes that the deoxidation of the hæmoglobin is due to combustion going on in the blood itself.

Bromised Derivatives of Pyruvic Acid.—E. Grimaux.—The author has obtained and examined the dibromopyruvic and tribromopyruvic acids.

Modifications Introduced into the Preparation of Reduced Iron.—M. Crolas.—The author maintains that *pulvis ferri* prepared by his method is chemically pure, and never evolves sulphuretted hydrogen during its stay in the stomach.

Determination of Lime in Meteoric Waters.—H. Marié-Davy.—The author has devised a volumetric method for the determination of lime. The solutions employed are chloride of calcium, oxalate of ammonia, and permanganate of potash. The standard lime solution is obtained by dissolving 1.786 grms. carbonate of lime in 1 litre of distilled water acidulated with pure hydrochloric acid. Each c.c. of this liquid contains 1 milligram of lime. The oxalic solution contains 16.429 grms. oxalate of ammonia per litre. For ordinary use this solution is diluted with twenty times its bulk of water. If the oxalate was neutral each c.c. of the diluted liquid would precipitate 0.2 milligram of lime, and would absorb 0.0714 milligram of oxygen to convert the oxalic acid into carbonic acid. The manganic solution contains 0.062 milligram permanganate of potash per litre. The author placed in a glass 20 c.c. of the lime liquor, and 81 c.c. of the dilute oxalic solution so as to ensure excess. On the other hand, he placed in a small flask 20 c.c. of water with 4 drops of hydrochloric acid. He heated till bubbles began to appear and then added the permanganate drop by drop till a permanent violet tint appeared. The permanganate employed was 0.60 c.c. This is the necessary correction for tint. 20 c.c. of distilled water, mixed with 1-10th of the oxalic solution and 4 drops of hydrochloric acid, treated in

the same manner, decolourised 14.05 c.c. of the permanganate, the correction for tint having been made. Each c.c. of the oxalic solution decolourises then 7.02 c.c. of the permanganate. The mean is then 7 c.c., a number which requires verification from time to time. The precipitation of oxalate of lime being complete, the clear supernatant liquid is decanted, and 15, 20, and 30 c.c. of this liquid are successively treated as above. The volumes of the permanganate decolourised have been 0.66, 0.65, and 0.66 per c.c. of water. The 101 c.c. of the total liquid would therefore decolourise 66.66 c.c. The 81 c.c. of oxalic solution employed would have decolourised $81 \times 7.0 = 567$. The quantity of oxalic acid withdrawn by the 20 milligrams of lime would therefore have decolourised 500.3 c.c., whence the author concludes—(1) That each c.c. of the oxalic solution would throw down 0.28 milligram in place of 0.25 of lime, and would absorb 0.08 milligram in place of 0.0714 milligram of oxygen. (2) That each c.c. of the manganic solution represents 0.040 milligram of lime, and 0.0114 milligram of oxygen.

April 13, 1874.

Remarks on the Spectrum of Aqueous Vapour observed in Aërostatic Voyage by M.M. J. Croce-Spinelli and Sivel.—M. Janssen.—The author recalls some observations in India and on the Red Sea, as showing that the vapour acts on all the solar radiations, from the rays of obscure heat to the ultra violet; the electric action appearing especially in the less refrangible part, and being due, he supposes, to an effect of temperature. M. Croce-Spinelli's observations confirm him in the belief that the sun has not reached that period of cooling at which aqueous vapour begins to form in the exterior envelopes.

Note of Baron Larrey on an Unpublished Work of M. Tollet, on a System of Incombustible Military Barracks and Hospitals of Ogival Form.

Note Accompanying the Presentation of the Fourth Volume of the "Memorial de l'Artillerie de la Marine."—M. Dupuy De Lome.—This volume contains an account of experiments which show that the generally received law, that the resistance of the air to artillery projectiles is proportional to cubes of their velocities, is approximately true only for mean velocities; for low velocities the resistance increases less quickly, and for high, more quickly than the cubes. In a note on explosive substances M. Sarrau has calculated, for various of these, the temperature and force of explosion, and the total work each of them is capable of furnishing. From sundry experiments the Naval authorities have been led to adopt, for guns of 14, 16, 19, and 24 centimetres, powder of the Belgian type of Wetteren, having an absolute density of 1.8, the grains (in cakes of 15 m.m. thickness) having a volume of $2\frac{1}{2}$ to 4 c.c. Attention is being given to the advantage (in the case of large cannon) of large prismatic or cylindrical grains of 20 to 25 c.c., pierced with seven small cylindrical holes. [A specimen of the powder was presented.] This geometrical disposition is useful, because, as the grains consume, the diameter of the holes increased, so that the productive surface of the gas increases, or at least remains constant; while, with ordinary massive grains, this surface is at its maximum at the beginning of the deflagration, and rapidly diminishes.

Extreme Smallness of the Apparent Diameter of Fixed Stars.—M. Stephan.—In various cases, by producing certain phenomena of interference, one may augment the sensibility of ordinary optical instruments. If a telescope be directed towards a luminous point, and be crossed by a screen pierced with two small apertures, there is formed in the focal plane a system of fringes alternately dark and bright, and by a simple theory the angle is known at which the distance, l , between the first two dark fringes will appear from the optical centre of the objective. Estimated in seconds of an arc, it is represented by the relation $\frac{103.1}{l}$ (the length of undulation

being supposed equal to 0.0005 m.m., and l expressed in millimetres). If the luminous source have sensible dimensions, its different points give rise to systems of fringes which encroach on one another. If, then, its diameter is equal or superior to $\frac{103.1}{l}$ the covering is complete, and the fringes disappear. If, on the other hand, the fringes persist, we may conclude that the diameter of the source is less than the proportion named. This is the principle M. Stephan applied. He used a lunular screen, the larger axes of the lunules being parallel, and 65 centimetres apart. Having made a large number of observations, he finds that none of the stars examined (Sirius included) had an apparent diameter which reaches 0.158". All presented fringes. It is remarkable, too, that, with all the stars (the observer being the same) the appearance of fringes commenced at the same magnification. M. Stephan perceived it first at a magnification of 600, never under this. Thus the mutual encroachment of the system of fringes produced by the extreme waves may be neglected in comparison with the separation of the bands of each system. In other words, not only is the apparent diameter of those stars less than 0.158", but it is a very small fraction of this number.

Temperature of the Solar Surface.—M. Vicaire.—The author argues that P. Secchi's estimate is still (though reduced to two cyphers less than formerly) far from the reality, which probably does not exceed a few thousand degrees.

Determination of the Calorific Intensity of the Solar Flux.—Extract from memoir by M. Duponchel.—Spectrum analysis has proved the similarity of composition of all stars, and probably the specific heat of the sun is equal to that of our earths and metals, the average of which is not more than 0.12. M. Martius's observations in 1864 showed that the calorific radiation emitted per square metre of the solar surface could not be less than 9,356,000 calories per minute (a number eleven times higher than that given by Pouillet). Applying these figures to Pouillet's problem, the gradual cooling of the sun, from equal and constant radiation into space, would correspond to an annual lowering, not of 1-100th of a degree, but of 140° at least in the mean temperature of its entire mass (supposing perfect conductivity). Such a result shows the necessity of explaining the calorific effects of the sun by an incessant cause of renewal of heat other than any that have been suggested hitherto. M. Duponchel requested the opening of a sealed packet put in the hands of the Secretary in December, 1873, in which he advances a theory of "circulation of calorific movement in planetary systems." He supposes a calorific and luminous flux emitted by the photosphere principally in the plane of its equator, and which he terms the *arterial flux*, and there is a corresponding *venous flux*, equal and contrary in direction, going to the poles. These two fluxes of heat, having points of departure and of arrival little different, in all the regions of space, being nearly parallel or concentric and rigorously equal, the venous flux constantly restores to the sun the heat emitted by the arterial flux. The two fluxes may be considered as the two branches of the same current or circuit of vibration of the ether, occurring in the photosphere which it traverses from the regions of the poles to those of the equator, its ascending branch being diffused, and its descending branch concentrated uniformly in all the regions of space.

Influence of a Vibrating Membrane on the Vibration of a Column of Air.—M. Gripon.—If a tuning-fork mounted in its case be vibrated, and a membrane of collodion or vegetable paper vibrating in unison with it, be placed near the opening of the case (at 4 or 8 centimetres) the intense sound from the case is greatly weakened, and, it may be, extinguished. (No such effect is observed if the membrane give a different sound from the instrument, or if a solid plate be used instead). Membrane and air both cease to vibrate. The latter will only vibrate anew

if a fork of higher pitch be substituted on the case. M. Gripon describes several other experiments of a similar nature.

Experiment Demonstrating the Part Played by the Veins in Absorption.—M. Oré.—This is an improvement on Magendie's method.

Aërostatic Ascent on March 22 by MM. Croce Spinelli and Sivel.—This second note is devoted to meteorological facts. The route of the balloon is shown in a drawing. Among other things, the authors mention having passed through a mass of very light needle-shaped ice crystals at about 5000 metres. They were from 20 to 40 centimetres apart, and sparkled so as to be visible at 100 metres. The temperature, $+13^{\circ}$ at starting, fell to zero on passing through a cloud, rose again to $+2^{\circ}$ above the cloud, and progressively decreased to -22° at 7000 metres. The hair hygrometer, which marked 62° at the ground corresponding to $+13^{\circ}$, marked only 54° at 7300 metres. Two currents were observed; the one, limited by the cloud at 1800 metres, had a velocity of 9 to 12 metres per second, and a direction between W. and W.S.W.; the higher current, much thicker, had a direction between N.W. and N.N.W., and was moving 21 or 22 metres per second. It is to be noted that on March 23, the day after the ascent, the current at the ground was N.N.W., on the 24th N., and the 25th N.N.E. The current above seems to have dominated over that below.

Observations apropos of a Note by M. Moreau on the Application of the Physometer to Studying the Function of the Swimming Bladder.—M. Harting.—The author has made many experiments with his physometer during the last two years, but mostly on fresh water fish, and he gives his conclusions (which he does not apply to all fish with bladders). The chief causes of variation of volume of the bladder are—(1) Ascent and descent in the water by action of the fins (change of pressure); (2) secretion and absorption of gases contained in the bladder; (3) respiratory movements. This influence was not seen in all the species examined. It is shown by small oscillations in the water column, each oscillation composed of a rapid and direct ascent, and of three smaller oscillations during descent. (4) The active compression of the bladder through a muscular contraction. This was rare, and the diminution caused by it very small. M. Harting concludes that the active rôle of the swimming bladder in descent and ascent in the water is, for the fishes examined, almost nil.

Apparatus Indicating Automatically the Presence of Blocks of Ice or Icebergs about Ships.—M. Michel.—A case suspended from the side of the ship encloses a bimetallic thermometer with a small rod attached to the helix, which moves right or left according as the temperature of the latter rises or falls. When the temperature falls the rod comes against a small metallic knob and thus closes a circuit, ringing a bell placed near the officer on watch.

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Liebig's Annalen der Chemie und Pharmacie.

March 8, 1874.

Aldehyd Derivatives of Naphthylamin.—Dr. G. Papisogli.—The author suspended recently distilled naphthylamin in water at 50°C ., into which a current of sulphurous acid was passed. The naphthylamin gradually dissolved, forming a reddish yellow liquid. On cooling, a polysulphite crystallised out in nacreous leaflets grouped together in the form of rosettes. If, however, the warm aqueous solution of sulphite of naphthylamin, containing excess of sulphurous acid, is mixed with benzaldehyd, added drop by drop with constant stirring, a precipitate is formed which re-dissolves, and on cooling dendritically arranged leaflets of an aldehyd compound make their appearance. This is naphthylamin-benzol-bisulphite, $\text{C}_{10}\text{H}_9\text{N}, \text{SH}_2\text{O}_3, \text{C}_7\text{H}_6\text{O}$.

Action of Amides upon Phenols.—Dr. J. Guareschi.—The author has studied the action of benzamid and

phenol, of acetamid and phenol, of benzamid and cresol, of benzamid and salicylate of methyl, and of benzamid and salicylate of ethyl.

History of Cymol.—Dr. J. Guareschi.—An account of experiments undertaken with the oil of cumin, in which he recognises two cymols, one of which turns the plane of polarisation to the right.

On Aconic Acid.—Fr. Meilly.—A very lengthy paper, not adapted for abstraction.

Eklogite of Upper Franconia.—Dr. v. Gerichten.—A specimen from Eppenreuth, near Hof. It contains red-brown garnet, with finely developed surfaces $\infty 0.202$, of a size generally exceeding 5 m.m. Omphacite is also interspersed in grass-green granules, often interrupted by radiating crystals of disthene and limpid grains of quartz. Needles of apatite and granules of iron pyrites are also observed. Magnetic pyrites is probably also present. The powder is white with a faint reddish tinge. Specific gravity = 3.40 :—

Silica	57.10
Phosphoric acid	traces
Alumina	11.16
Ferric oxide	2.84
Ferrous oxide	3.22
Lime	13.80
Magnesia	6.37
Manganese protoxide	0.31
Potash	0.81
Soda	2.21
Water	0.54

98.92

An Eklogite from Silberbach, near Conradsreuth, has a fine-grained radiating appearance from the predominance of leek-green omphacite, notwithstanding the large embedded garnets. It contains less disthene and quartz than the former. Its powder is grey, and its specific gravity = 3.42 ; it contains—

Silica	55.00
Phosphoric acid	traces
Alumina	13.54
Ferric oxide	2.74
Ferrous oxide	3.37
Manganese protoxide	0.20
Lime	12.09
Magnesia	10.21
Potash	0.50
Soda	2.10
Water	0.32

100.07

A third specimen from Mark Schorgast contained disthene, carinthin, muscovite, biotite, oligoclase, quartz, hyacinth, olivin, apatite, magnetic pyrites, and ordinary iron pyrites. Its composition is—

Silica	48.81
Zirconia	traces
Phosphoric acid	
Sulphur	16.25
Alumina	
Ferric oxide	6.00
Ferrous oxide	7.48
Manganese protoxide	0.43
Lime	9.72
Magnesia	7.52
Potash	0.46
Soda	2.64
Water	0.12

99.43

The author gives also the analyses of several other specimens, points out the chemical and geological bearings of his researches, and gives, in conclusion the bibliography of the subject.

Method for the Analysis of Crystalline Minerals.—Dr. v. Gerichten.—Particular weight must be laid on certain preliminary operations which are too often overlooked.

A. (1) Microscopic examination of a thin section. To the experienced eye examination with a good lens is often sufficient. (2) Qualitative examination of fragments from different portions of the mass. Especial attention should be paid to the rarer bases and acids, such as phosphoric acid, chlorine and fluorine, sulphuric acid, titanium, sulphide of hydrogen, chrome, zirconia, glucina, strontia, lithia, &c. (3) Separation of the constituents found mixed in the mass, either mechanically or chemically, with weak acids, fusion, and subsequent treatment with acids. (4) Pulverisation for the subsequent quantitative examination. For this purpose pieces should be selected which have a fresh appearance. In coarse grained varieties portions are taken which fairly represent the general type of the rock or mineral. The operation of pulverising is best performed in a steel mortar. The powder is then sifted through lawn, care being taken that the harder granules, e.g., beryll or zircon, do not remain on the sieve. The powder is preserved in stoppered bottles perfectly air dry.

B. In the quantitative analysis the constituents generally met with are silicic and phosphoric acids, chlorine, alumina, the oxides of iron, oxide of manganese, lime, magnesia, potash, soda, and water. (1) Determination of water. (a). Hygroscopic moisture. The substance is dried in the exsiccator. (b). Determination of the water according to Ludwig's method (Tschermak's *Mineral. Mittheilungen*, 1872, (3), 188). Ignition to a white heat in a platinum tube, and weighing in a chloride of calcium apparatus. (2) Phosphoric acid. About 1 grm. of the sample is fused with carbonate of potash-soda, taken up with water, evaporated to dryness with hydrochloric acid, re-dissolved with dilute hydrochloric acid, the filtrate precipitated with molybdate of ammonia, and the phosphoric acid finally determined as pyrophosphate of magnesia. (Although phosphoric acid generally occurs as apatite, which can be decomposed by nitric acid, it is in every case preferable to proceed as above directed.) (3) Protoxide of iron. (a). Soluble in hydrochloric acid. Variable quantities of the specimen up to 1 grm. (according to the proportion of matter soluble in hydrochloric acid) are heated with concentrated hydrochloric acid in a sealed glass tube to 120° to 150° C. for one or two hours, and the solution titrated with permanganate. (b). Insoluble in hydrochloric acid. About 0.5 grm. of the substance, mixed with a few drops of hydrochloric acid, is placed in a covered platinum crucible, provided with a short entrance and exit tube of platinum, and treated with recently prepared and concentrated hydrofluoric acid in an atmosphere of carbonic acid, evaporated gradually to dryness in the same gas, and titrated with permanganate. (It may be advantageous to preserve the powdered portions destined for the determination of protoxide of iron in sealed glass tubes filled with carbonic acid.) (4) In general, in the further analysis, the portion soluble in hydrochloric acid is examined separately from the part unattacked by the same solvent. Such a method can never give much better indication than a lump analysis.* The degrees of decomposability of the silicates by acids are only approximately known, and the partial decomposition of a silicate considered as insoluble by hydrochloric acid according as the action is more or less prolonged, or the acid more or less concentrated, is quite unable to throw a light upon complicated mixtures of silicates. Even in fine-grained minerals it is worth the trouble to separate the constituent parts of the mixture by means of lens and forceps, and to analyse them apart. If the texture of the specimen is very fine and homogeneous, then—until researches have been carried out which indicate the limits of the decomposition of the various silicates in stronger or weaker acids and at different degrees of pressure—we are obliged to under-

take a partial analysis of the portions respectively soluble and insoluble in hydrochloric acid. (a). Portion soluble in hydrochloric acid. 2 to 3 grms. of the substance are heated with hydrochloric acid to a high temperature in a sealed glass tube. In repeating an analysis the same temperature should be maintained (See Rammelsberg, "Quantitative Chemical Analysis of Minerals and Furnace Products," page 175). All the phosphoric acid of the mineral is found in the ammoniacal precipitate. In the separation of the iron and the alumina the hyposulphite of soda method can scarcely be recommended. The potash method is better, but titration with permanganate surpasses both in simplicity and accuracy. (b). The residue insoluble in hydrochloric acid is divided in three portions; two of these are set apart for the further determination of the silicic acid (see Rammelsberg). The third portion is decomposed with hydrofluoric acid, for the determination of the alkalies taken up in hydrochloric acid, and evaporated to dryness, dissolved in water, filtered, oxidised with nitric acid, concentrated as far as possible, mixed with carbonate and hydrate of baryta, and the separation of magnesia and the alkalies completed in the ordinary manner. In "lump analyses" it is well to determine the lime once as carbonate and again as sulphate. The determination of the alkalies is preferably executed on an especial portion.

Titaniferous Iron of Abnormal Composition.—Dr. v. Gerichten.—The material for this investigation was taken from a splendid crystal of titaniferous iron in the mineralogical cabinet of the University of Wurzburg. Its locality is supposed to be Norway. The only substances present are titaniferous acid, ferric oxide, and a small quantity of ferrous oxide. Magnesia and silica could not be detected. Its composition is—

Titaniferous acid	46.42
Ferric oxide	52.67
Ferrous oxide	1.07
	—
	100.16

This specimen belongs, therefore, to none of the three classes distinguished by Rammelsberg. As regards the execution of the analysis, it may be mentioned that the mineral was dissolved in hydrochloric acid in a sealed tube. For comparison it had been previously analysed after solution by means of bisulphate of potash. The procedure was as follows:—The weighed substance was heated with concentrated hydrochloric acid to 140° to 180° C. for two to three hours in a sealed tube of good Bohemian glass. The powder, deep brown at first, became a pale yellow. The tube was opened, the contents poured into boiling water, and filtered. In the solution was merely ferric oxide, whilst the residue consisted of titaniferous acid, coloured yellow by a trace of iron. The residue was dried, weighed, and fused with bisulphate of potash, when the titaniferous acid is separated as a snow-white powder, perfectly free from iron, and may be weighed. The ferric oxide in the first solution was reduced with zinc, and titrated with permanganate. The ferrous oxide was determined in a separate portion.

Abnormal Constituents of Urine after the Consumption of Asparagus.—A. Hilger.—Succinic acid was relatively abundant, the amount of hippuric acid was increased. Benzoic acid was recognised, but no asparagin. The ammonia was increased to 6.24 grms. in 3000 c.c.

Solubility of Selenium and Tellurium in Sulphuric Acid.—A. Hilger.—It is generally stated in chemical text-books that tellurium dissolves in concentrated sulphuric acid with a purple colour, and is precipitated unchanged on the addition of water. A possible oxidation of the tellurium is not mentioned, though H. Rose states that if the solution is heated sulphurous and tellurous acid are formed. The solubility of selenium in sulphuric acid with a green colour is also mentioned, the selenium being re-deposited unchanged on the addition of water.

* *Bausch analyse*, where an entire mineral, or an accidental mixture of several chemical compounds, is analysed in the lump.

Fischer and Gmelin speak of an accompanying oxidation. Rose's statement was confirmed by experiment. With selenium the case is similar; it is not precipitated by the addition of water to its solution, but by chloride of tin.

Quantitative Determination of Iodine in Urine.—

A. Hilger.—The author recommends the use of chloride of palladium. The urine must be previously acidified with hydrochloric acid. The removal of sulphuric and phosphoric acids is not needful.

Synthesis of Phenyl-butylen.—B. Aronheim.—This paper does not admit of abstraction.

Isomeric Pyruvic Acid, "Ethylmalonic Acid."—

A. Tupoleff.—The author has examined the baryta silver salts of this acid.

Ether of Mono-bromo-butyric Acid.—A. Tupoleff.

—The author finds that this ether boils at 174°C ., or with correction 178° .

Certain Derivatives of the Primary Butyl Alcohols.

—M. Grabowsky and Alexander Saytzeff.—This paper is unsuited for abstraction.

Reduction of Succinyl Chloride.—Alexander Saytzeff.

—A lengthy paper, containing much hypothetical matter.

Determination of the Position-Formulae of the Allyl Compounds, and of Acrylic Acid.—E. Linnemann.

—The author concludes that the propionic acid formed from acrylic acid is in every respect identical with the well-known normal propionic acid.

α -Bibrom-Propionic Acid.—O. Philippi and B. Tollens.

—Unsuited for abstraction.

On α -Monobrom-Acrylic Acid, and Conversion of α Bibrom-Propionic Acid into the β Acid.—O. Philippi and B. Tollens.—The author concludes that "the carboxylic group is contained in the β -bibrom-propionic acid, and in its derivative acrylic acid."

On β -Monobrom-Acrylic Acid obtained from β -Bibrom-Propionic Acid.—R. Wagner and B. Tollens.

Secondary Products of the Preparation of β -Monobrom-Acrylic Acid, Acrylcolloids.—R. Wagner and B. Tollens.

Theory of Dissociation or Thermolysis.—Fr. Mohr.

—The theory of dissociation may be summed up in the following propositions:—(1) Dissociation is the opposite process to chemical combination, the gaseous body resuming its molecular motion which it lost on combination as heat, and converting it into a new form of motion. (2) The amount of heat which the dissociated bodies take up is exactly equal to that which they lose on combination. (3) The temperature of separation is higher than the temperature of combination. (4) Compounds whose constituents are not volatile cannot be separated by heat.

Octylic and Caprylic Acids.—J. J. van Renesse.—The author describes caprylic acid, caprylic ether, and the caprylates of barium, calcium, and zinc, and compares the properties of these bodies with the analogous octyl compounds.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in, and apparatus for, the manufacture of sulphate of soda, chlorine, hydrochloric acid, and cements. Hartley Kenyon, of the firm of Kenyon Brothers, manufacturing chemists, and Israel Swindells, analytical chemist, both of Warrington, Lancaster. August 19, 1873.—No. 2739. The features of novelty in this invention consist in mixing salt and its equivalent of sulphur together, and burning the same in furnaces, leading the gases evolved through a dried mixture of salt and alkali-makers' waste contained in a heated chamber of special construction, by which means the sulphur is ignited, and in burning alkali-makers' waste in any suitable furnace along with air and steam, and passing the gases through the contents of the same heated chamber, after which such gases are passed through towers and scrubbers for the purposes described, the residuum being useful in the manufacture of hydraulic and other cements. The chamber or cupola is of a cylindrical form, and is surrounded by a spiral flue leading from the furnaces, by which means it is heated by the products of combustion in passing to the chimney.

Improvements in means and apparatus for the impregnation of air for supplying the lungs or other parts of the body. Pierre Villiers, M.D., College Street, Fulham, and Joseph Mayer, Great Portland Street, Middlesex. August 20, 1873.—No. 2751. The object of the invention is to supply increased quantities of oxygen or other gases or vapours to atmospheric air, and to facilitate the conducting of the impregnated air to the lungs, or it may be to wounds or other openings on the surface of the body. For this purpose the impregnating material is applied in a small chamber open at the top, but enclosed in a larger and close chamber. The air to be impregnated is forced by a hand ball inflator, or other suitable forcing means, through a tube into and through the cover of the larger chamber to near the bottom of the inner chamber, so that it may be distributed amongst the matters in that vessel to absorb gas therefrom. This impregnated air thence passes away by another tube, by which and a suitable mouth-piece it may be inhaled by a consumptive or other patient, or, by adopting other forms of outlet, the impregnated air may be forced into a wound or other opening. For the supply of oxygen, camphor of Borneo is employed, combined with either rosin from cedar or from spruce-fir, or essence of canella, or turpentine, or cachou (Japan-earth), or Italian essence, or royal essence, or American white turpentine, or Mecha's turpentine, or chios (or Greek) turpentine, or maritime spruce-fir turpentine. In the respective cases, the matters are combined in equal proportions, though they do not confine themselves thereto, and then, having well mixed the particular combination, it is subjected to a heating process for purification.

Improvements in the treatment of night-soil, sewage, and other like refuse matters, and in the production of materials capable of being employed for the purposes of deodorisation. William Henry Hughan, Morningside, Eccles, Lancaster. August 20, 1873.—No. 2760. The essential points of this invention have reference to the treatment of sewage, night-soil, and other refuse, and consist in employing materials such as peat, sand, sawdust, coal, coke, sea-weed, or other vegetable matters, and also, domestic, town, farm, or other refuse, or sweepings or ashes, in conjunction with clay, sand, portland or other cement, magnesia or magnesium limestone, salt, or mixtures of two or more of the same, in order that the resulting combination, after having been submitted to a carbonising process, shall form what is termed a cement or carbonised product.

An improved solvent, obtained by the distillation of crude turpentine. George Haseltine, LL.D., Southampton Buildings, London. (A communication from Richard Lloyd, New Orleans, Louisiana, U.S.A.). August 20, 1873.—No. 2761. The present invention consists in producing a solvent, which is a product resulting from the distillation of crude turpentine at an exceedingly low temperature, and the separation of the pyroligneous acid water therefrom while in vapour.

An improved manufacture of soap. Richard Gibbon, Warwick House, Maidstone, Kent. August 21, 1873.—No. 2766. The object of the invention is to obtain soap possessing increased cleansing properties, particularly adapted for laundry and such like uses, and this is effected by the combination with the soap, during manufacture, of the best imperial or other blue.

Improved means of, and apparatus for, condensing and rendering harmless arsenious, chlorous, sulphurous, and other unpleasant and deleterious gases or vapours that are given off in the manufacture of portland and other cements and limes, as well as in the treatment of mineral and metallic ores. Sampson Taylor Rowe, analytical chemist, Redruth, Cornwall, and Isaac Charles Johnson, cement manufacturer, London. August 21, 1873.—No. 2769. This mainly consists in fitting an intermediate downcast shaft between the upcast and the chimney, water being permitted to fall and spread to condense the vapours.

Improvements in the method of treating zinc alloys for the purpose of recovering the zinc therefrom. James Wright, civil engineer, Gresham House, Old Broad Street, London. (A communication from Mariano Guillem, Marseilles, France). August 21, 1873.—No. 2778. My invention relates to an improved method of recovering zinc which has been used for de-silvering or separating other metals, chiefly lead. To carry this out, I arrange in a furnace one or more dry crucibles or melting-pots, into which the alloy containing the zinc is placed. A tube passes from each of the crucibles, and connects it with a closed receiver; the mouth of the crucible and the pipe connections with the crucible and receiver, as well as the crucible mouth, being luted or hermetically closed, the furnace is brought into action, and, upon a white heat being obtained, the zinc volatilises, and passes through the pipe into the receiver, where it is deposited in a metallic state.

NOTES AND QUERIES.

Alumina.—Can anyone inform me whether alumina melts before the oxyhydrogen-flame into a clear transparent globule, as stated in some works, or into an opaque bead?—AL.

Bleaching Oils.—Can any of your valued correspondents kindly inform me, through the medium of the CHEMICAL NEWS, how to bleach a dark oil and the stearine pressed from a brown animal grease produced in tanneries.—A YOUNG CHEMIST.

Cleaning Wire Blinds.—Although I have taken in your valuable publication for more than ten years past (to send to my son in India), I have never before troubled you with any correspondence, and, if you will not think it impertinent of an old lady of seventy-eight, I shall feel grateful if you will give me the following information either in your CHEMICAL NEWS or direct. I have some valuable wire window blinds, but unfortunately they have got my late dear husband's name, &c., on in gold-leaf, &c. (I presume). I am desirous to remove the letters without injuring the delicate wire, so as to be able to use the blinds for my private home. Will you be good enough to tell me how to do this; although a doctor's wife I know little of chemistry, and my son is too far away to give me immediate information.—J. S.

THE CHEMICAL NEWS.

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NOTE ON ANTIMONY TRI-IODIDE.

By R. W. EMERSON MACIVOR.

WHEN an intimate mixture of finely-powdered metallic antimony with dry iodine is heated in a porcelain basin over which an inverted glass funnel is placed, orange-red vapours of antimony tri-iodide are given off, which condense within the funnel to form very fine, transparent, scarlet-coloured scales. The product thus obtained, however, always contains more or less uncombined iodine, which may be removed by mixing the impure substance with powdered antimony, and subjecting it to re-sublimation. Antimony tri-iodide may also be obtained by the action of heat on a mixture of antimonious sulphate with dried potassium iodide. It is also formed by heating antimony tribromide with potassium iodide.

Antimony tri-iodide, SbI_3 , when heated to a temperature of 165.5°C ., fuses to a reddish-brown coloured liquid, resembling bromine in appearance, which enters into ebullition at an elevated temperature. It is soluble in alcohol and carbon disulphide, but is insoluble in benzol. Cold concentrated hydrochloric acid does not dissolve it, but on the application of heat it is easily soluble in that menstruum. By heating with strong sulphuric acid, it is decomposed, antimonious sulphate being formed. Strong nitric acid also decomposes it when assisted by heat.

Antimony oxy-iodide, $\text{Sb}_4\text{I}_2\text{O}_5(?)$, is a lemon-yellow precipitate formed by the action of hot water on the tri-iodide.

38, Gladstone Street, St. George's Road,
Glasgow.

ON THE CHEMICAL EXAMINATION AND COMPARATIVE COMPOSITION OF SOME SPECIMENS OF PRESERVED MEAT.

By THOMAS ROBERTSON OGILVIE, F.C.S.,
Joint Public Analyst, Greenock.

No. II.

I WILL feel obliged if you will allow me to reply to some remarks by Mr. Moore in CHEMICAL NEWS, vol. xxix., p. 205, on a paper of mine on the above subject.

(1). Mr. Moore questions the statement that the "alcoholic extract" contains the organic principles, creatin, inosic acid, &c., because they are not soluble in cold alcohol, and nearly insoluble in hot. His objection would be valid if cold absolute alcohol had been used; but, as these bodies are taken up by aqueous alcohol, and as such was used in the analyses, it is quite unfounded. In support of this statement, I will simply say that Liebig—than whom no one should be listened to with greater respect regarding these bodies—states that true extract contains 80 per cent soluble in 85 per cent alcohol, and directs that the creatin and creatinin be searched for in the alcoholic solution. Similar assertions have been made by other authorities, and, as they remain unchallenged, I adhere to the strict accuracy of my statement.

(2). I fail to perceive the point of Mr. Moore's reference to the use of the term "fibrin or syntonin." No one, I think, who gives the slightest consideration to the matter would conclude that it refers to anything else than the insoluble portion of flesh which remains after treatment with water, and which is always known as muscle-fibrin

or syntonin, in contradistinction to blood-fibrin. There is not one word in my paper to suggest that I am not cognisant of the characteristics of the different forms of fibrin; so that, while anything Mr. Moore says on that subject may be of interest in the proper place, his remarks are altogether irrelevant as criticisms on my paper. I hold that the phrase in question is quite intelligible and strictly accurate.

(3). Mr. Moore asserts: "there is no justification for the statement 'thus fat is not only indispensable in the process of repair of all cellular and fibrous matter, but is also necessary for the digestion of the other elements of food,' for herbivorous animals take but little fat in the food they eat, yet they convert starchy matter largely to fat." Well, I repeat the statement, and hold emphatically that it is essentially correct. In support of my position, I beg to cite the following authorities:—

(a). "The azotised compounds, when taken alone, are insufficient to support life; saccharine and oleaginous matters are absolutely necessary, and in the young even of carnivora they form, in the shape of milk, a most important part of their nutriment. Even the flesh diet of the carnivora contains a large proportion of fat, which supplies the necessary material of this kind."—(Miller's "Elements of Chemistry," 4th edition, Part III., pp. 192-3.)

(b). "The association of oleaginous with albuminous matter seems to be essential in every act of nutrition. We find the two combined in the yolk of the egg, in the chyle, and in the organisable *blastema* exuded for the reparation of breaches of substance."—(Carpenter's "Manual of Physiology," 4th edition, p. 322.)

(c). "It is obvious that if flesh employed as food is again to become flesh in the body, if it is to retain the power of reproducing itself in its original condition, none of the constituents of raw flesh ought to be withdrawn from it during its preparation for food. If its composition be altered in any way, if one of the constituents which belong essentially to its composition be removed, a corresponding variation must take place in the power of that piece of flesh to re-assume in the living body the original form and quantity on which its properties in the living organism depend."—(Liebig, "On the Chemistry of Food," p. 122.)

(d). "When we consider all these facts, we shall be almost involuntarily led to the conclusion that fat takes a highly important share in the most important, and at the same time the most mysterious, processes in the formation of cells and tissues. We cannot believe that fat is a mere incidental agent in all these processes, but we must rather regard it as of essential aid in the process of converting nitrogenous nutrient substances into cells and masses of fibres in like manner as it co-operates in the processes of lactic acid fermentation and digestion, and it is probable that, whenever a chemical equation representing the formation and function of certain cells can be established, fat will constitute one of the integral factors. . . . None but those chemists who, imagining they comprehend Liebig's views, have formed and illustrated a physiology of their own, could have regarded the animal economy as a furnace, and fat as a simple and crude material for combustion."—(Lehmann's "Physiological Chemistry," vol. i., pp. 268-9.)

"We also at the same time drew special attention to the fact that no animal cell and no fibre was formed independently of the presence of fat. Indeed, the fat appears to possess the property of predisposing the animal organism to the formation of cells."—(Lehmann's "Physiological Chemistry," vol. iii., p. 211.)

If "there is no justification" for my statement, then there is as little for any of the assertions made by the eminent and credible authorities I have just quoted. Into the old controversy between Boussingault, Dumas, Milne-Edwards, Liebig, Persoz, Scherer, and others, regarding the change of starch and sugar into fat in the animal organism, I do not intend to enter. To any careful reader, it must be apparent that the statement which has been

pronounced to have "no justification" had special reference to the necessity for the whole constituents of flesh being eaten together, so as to obtain their proper and full nourishing value; and if Mr. Moore can substantiate that the people in this country, who every day consume such articles of diet as butcher-meat, butter, milk, or other substances containing fatty or oleaginous matter, can subsist in good health on nitrogenous and non-nitrogenous matters which are entirely destitute of any quantity of fat, then he will show reason for the stricture he has made, but in the meantime he has produced none whatever.

(4). Mr. Moore says "it cannot matter whether fat is necessary for the repair of those tissues (cellular and fibrous), though it is well known that neither of them contain fat." I did not in the slightest way suggest that they contained fat; what I said was, that fat is indispensable in their repair, that is, indispensable as an agent in their repair.

(5). "As without them (the salts) the other bodies could not be ingested," I have to acknowledge that Mr. Moore has laid his finger on a real error here, and I am grateful to him for doing so. The word "ingested" should be "digested," as written in my manuscript, but as the article was printed from a copy by an amanuensis, I cannot say exactly how the one word was substituted for the other. One or two other clerical slips in the paper would have been corrected if the article had not been printed before the proof was returned.

(6). I have neither "fallen into a greater error," nor have I "been misinformed" in saying that creatin corresponds in chemical relationship with caffeine or theine. Does Mr. Moore mean to say that two bodies such as creatin and caffeine, which have the same component elements, form crystalline salts with certain acids, have a bitter taste, and correspond in their solubility in the same solvents, do not correspond in chemical relationship? I am aware that the products of the decomposition of each are different, but that does not render it a "greater error" to say that they resemble each other in the characteristics mentioned. I hold, therefore, that Mr. Moore's phrase "greater error" is quite uncalled for.

(7). Mr. Moore further remarks: "So far from exciting mental activity, urea and creatin produce coma, and lactic acid produces variously, if in excess, rheumatics, rickets, or mollities ossium." Let me say that any statement as to the action of these bodies *in excess* is entirely irrelevant in discussing their action when present in the normal quantities, in which they occur in flesh, or in the proportion of beef-tea or meat-extract usually taken. It would be as logical to say that, because alcohol when taken in excess is poisonous, that therefore a light wine, when used in moderation, is also poisonous. Would it be justifiable to argue that, because caffeine in quantities of from 2 to 10 grains produces palpitation of the heart, intermission of the pulse, confusion of the senses and delirium, that therefore the question whether coffee or tea, as usually taken by people of moderate taste, are beneficial, "is still an unsettled point." But, further, we can deduce but little guidance in estimating the value and influence of the juice of flesh, beef-tea, or Liebig's extract by experimenting with their constituent principles individually. For instance, it has been shown that the action of caffeine, when freed from its associated bodies, in no way explains the stimulating and reviving power of coffee. And neither does the action of the organic principles and mineral salts present in the juice of flesh, when they are experimented with separately, give any specific indication of their action on the human system, when taken as associated together in their natural condition and proportions. Although familiar with the experiments of Bogoslowsky and others when writing the paper under discussion, I purposely left them in abeyance because they are objectionable on this ground. They are interesting as experiments, but can only be viewed as suggestive or tentative for other and more exact ones.

I hold, therefore, the view of the most trustworthy

inquirers on this subject, that while meat extract does not give actual strength, it gives the sensation of vigour, by a peculiar stimulating or restorative action on the nervous system; and further, that in the present state of our knowledge we are warranted in attributing that power to the "extractive bodies" referred to. If Mr. Moore means to say, by referring to Bogoslowsky's experiments, that extract of beef solution acts in exactly the same way as warm water, and that in certain doses it has a poisonous influence, I venture to say that he holds views which are in direct opposition to those of nearly the entire medical faculty, whose knowledge on this matter is based, not upon empirical laboratory experiments, but upon the direct and long-continued observation of its effects upon the human system. If he does not hold such views, then the experiments he quotes are foreign to the discussion, or he should have defined the exact interpretation he puts upon them.

If he admits that preserved mutton "is largely used in asylums, prisons, and workhouses" (and he might have quite safely added, by all classes of society outside of these buildings as well), "and the inmates of which undoubtedly preserve their health and strength in a remarkable manner," and that it is "an excellent food," then I think, irrespective of scientific evidence, he is bound to grant that meat extract is beneficial, because it also is largely used in hospitals, is an almost invariable article in the sick room, and of late has come into general use for soup-making, and in all these cases with the best results.

In conclusion, while I reciprocate the expression of good feeling with which Mr. Moore closes his letter, I cannot refrain from saying that a series of more unfounded and hypercritical strictures than it contains I do not recollect at any time to have read in the pages of your journal.

ON THE DISSOCIATION OF CERTAIN COMPOUNDS AT VERY LOW TEMPERATURES.

By A. R. LEEDS,

Prof. Chemistry, Stevens Institute of Technology.

It has been shown by Fittig* that ammoniac chloride, when in solution in water, is decomposed by boiling. H. C. Debbits† has recently investigated other salts of ammonia, especially the nitrate, sulphate, oxalate, and acetate, and has found that all of these liberate ammonia, not only when their solutions are boiled, but also, in case a current of pure hydrogen is passed through their saturated solutions, at the ordinary temperatures and even at 0° C. This latter observation is a confirmation of what was stated previously by Gernez,‡ that when an inert gas like hydrogen or nitrogen is passed through a salt in solution or in the fused condition, it causes the liberation of a certain constant quantity of that one of the constituents which is volatile at the temperature of the experiment. This is true of the hydrosulphates, the bisulphites, the biacetates and the bicarbonates, a solution of potassic bicarbonate "even at ten degrees liberating increasing quantities of carbonic acid." In like manner the nitrates may be made to set free a portion of the acid at temperatures far below those which are ordinarily regarded as their decomposing points.

The object of the present investigation is to establish:—

1st. That it is not necessary to change the atmosphere in contact with the particles of the salt held in solution, by passing a current of an inert gas, in order to induce dissociation at temperatures below the boiling point.

2nd. That there is a certain fixed temperature, which is different in the various salts, at which the dissociated

* *Ann. Chem. Pharm.*, cxxviii., s. 189.

† *Ber. der Deutsch. Chem. Gesell.*, v., p. 820.

‡ *Comptes Rendus*, lxiv., p. 606.

constituent can be detected and recognised by sufficiently delicate tests.

3rd. That it is highly probable that the dissociation of these salts in solution is analogous to the evaporation of the solvent, and that while it arrives at a maximum, under ordinary atmospheric pressures, at the boiling-points of their saturated solutions, yet it takes place in a diminishing proportion at much lower temperatures, in some cases even below their freezing-points.

The reagent employed in these experiments was alizarin, an alcoholic solution of which will readily detect one part of soda in three millions of water, and a correspondingly small amount of potash, ammonia, &c. The apparatus consisted of a small flask, closed by a cork through which a delicate thermometer was passed with its bulb immersed below the surface of the liquid. A short tube entering the neck of the flask at right angles contained a coil of alizarin paper, dry and carefully supported out of contact with any moisture which might condense on the sides of the tube. The results of the experiments are given in the following table, Bar. 29·84—29·82 in.

The temperature of the solutions at the beginning of the experiments was 17°—20° C., and the increase was conducted very gradually and slowly, about a half hour being required for each determination. The alkaline reaction was made evident by quick and sharp transition from yellow to red of the alizarin paper at the temperatures indicated. In the case of ammoniac chloride it would at first appear that there was a progressively slow increase of the point of sensible dissociation with the dilution of the liquid, but this was probably owing to the extreme slowness with which the liberated ammonia from a very dilute solution diffused itself, rendering it difficult not to overstep the temperature actually requisite.

Liquid.	Reaction of Liquid.	Parts in 100.	Temp. deg. C.	Mean deg.	Reaction of Vapour.
Ammoniac Chloride.	Feebly acid	10·60	37	37	Strongly alk.
" "	" "	" "	37	37	" "
" "	" "	5·30	38	38·5	Alkaline. "
" "	" "	" "	39	" "	" "
" "	" "	2·65	39	" "	" "
" "	" "	" "	40	39·3	Feebly alk."
" "	" "	" "	39	" "	" "
" "	" "	1·325	39 39	" "	" "
" "	" "	" "	39 41	39·2	" "
" "	" "	" "	38 39	" "	" "
" Sulphate.	Acid.	45·62	50	50·5	Alkaline.
" "	" "	" "	51	" "	" "
" "	" "	22·81	51	51	" "
" "	" "	" "	51	" "	" "
" "	" "	11·40	50·5	50·5	Faintly alk.
" "	" "	" "	50·5	" "	" "
" Oxalate.	Strongly alk.	Saturated at 7·5° C.	—1	—1	Strongly alk.
" Acetate.	Acid.	Saturated at 17° C.	55	55	Alkaline.
" "	" "	" "	55	" "	" "

The ammoniac oxalate was surrounded by a freezing mixture, and when the mass was frozen, an alkaline reaction was obtained almost immediately on inserting the coil in the exit tube. The atmosphere surrounding the apparatus in this experiment was likewise below the freezing-point. It is probable that the point of sensible dissociation was much lower than that observed.

Finally, this point of sensible dissociation depends on the circumstances of the experiment, and the delicacy of the apparatus and reagents employed in its detection. For when a thermometer and a coil of paper supported at the distance of 3 m.m. from the surface of the liquid were placed in a sealed flask containing the ammoniac chloride solution employed in the first experiments, tabulated above, it was reddened at the expiration of an hour, the temperature being 20°, and when the flask was previously exhausted of air, at 17° C. The lower temperature in the last case was probably due to the rising of air bubbles into the vacuum above the liquid. The temperatures of sensible dissociation above given are not to be regarded therefore as absolute, but as relative and valuable only as indicative of the comparative dissociability of these salts when in aqueous solution.—*American Journal of Science and Arts.*

ON THE PHYSIOLOGICAL ACTION OF LIGHT.*

By JAMES DEWAR,
Lecturer on Chemistry, University of Edinburgh,
and JOHN G. M'KENDRICK, M.D.,
Demonstrator of Practical Physiology, University of Edinburgh.

I.

THE authors of this communication have more especially directed their attention to the problem of the specific effect produced on the retina and optic nerve by the action of light. Numerous hypotheses have been made from time to time by physicists and physiologists; but up to the present date our knowledge of the subject is without any experimental foundation. For example, Newton, Melloni, and Seebeck stated that the action of light on the retina consisted of a communication of mere vibrations; Young conjectured that it was a minute intermittent motion of some portion of the optic nerve; Du Bois-Reymond attributed it to an electrical effect; Draper supposed that it depended on a heating action of the choroid; and Mosier compared it to the action of light on a sensitive photographic plate.

It is evident that, in accordance with the principle of the transference of energy now universally accepted, the action of light on the retina must produce an equivalent result, which may be expressed, for example, as heat, chemical action, or electro-motive power. It is well known that the electro-motive force of a piece of muscle is diminished when it is caused to contract by its normal stimulus, the nervous energy conveyed along the nerve supplying it; and similarly a nerve suffers a diminution of its normal electro-motive force during action. In the same manner, the amount and variations of the electro-motive power of the optic nerve affected secondarily by the action of light on the retina, are physical expressions of certain changes produced in the latter; or, in other words, are functions of the external exciting energy, which in this case is light. Considerations such as these led us to form the opinion that the problem of what effect, if any, the action of light has on the electro-motive force of the retina and optic nerve, would require for its investigation very careful and refined experiment.

The inquiry divided itself into two parts,—first, to ascertain the electro-motive force of the retina and nerve; and, second, to observe whether this was altered in amount by the action of light. The electro-motive force of any living tissue can be readily determined by the method of Du Bois-Reymond. This great physiologist found that every point of the external surface of the eyeball of a large tench was positive to the artificial transverse section of the optic nerve, but negative to the longitudinal section. This he accomplished by the use of his well-known non-polarisable electrodes, formed of troughs of zinc carefully amalgamated, containing a solution of neutral sulphate of zinc, and having cushions of Swedish filter paper on which to rest the preparation. (To protect the preparation from the irritant action of the sulphate of zinc, a thin film or guard of sculptor's clay, moistened with a 0·75 per cent solution of common salt, and worked out to a point, is placed on each cushion). These electrodes were connected with a galvanometer, and the preparation was placed so that the eyeball, carefully freed from muscle, rested on the one clay-guard, while the transverse section of the optic nerve was in contact with the other. By following Du Bois-Reymond's method, we have had no difficulty in obtaining a strong deflection from the eyes of various rabbits, a cat, a dog, a pigeon, a tortoise, numerous frogs, and a gold-fish. The deflection was frequently so much as to drive the spot of light off the galvanometer scale.

With regard to the second question—namely, Whether, and to what extent, the electro-motive force would be affected by light? we found more difficulty. The method followed was to place the eyeball on the cushions in the

* Read before the Royal Society of Edinburgh.

manner above described, to note the deflection of the galvanometer needle, and then to observe whether or not any effect was produced on the impact of a beam of light, during its continuance, and on its removal. In a few of our earlier experiments we used Du Bois-Reymond's multiplying galvanometer, but finding the amount of deflection obtained was so small that the effect of light could not be readily observed, we have latterly used Sir W. Thomson's exceedingly sensitive reflecting galvanometer, kindly lent us by Professor Tait. We met also with secondary difficulties such as the dying of the nerve, the impossibility of maintaining an absolutely constant zero, and an absolutely constant amount of polarity, the effects of heat, &c.; but these difficulties we have overcome as far as possible by the most approved methods. The changes in polarity of the apparatus occurred slowly, and could not be mistaken for the changes produced by the action of light, which we found occurred suddenly, and lasted a short period of time. It is also important to state that the deflections we observed do not at present profess to be absolute, but only relative values. About five hundred observations were made previous to the date of this first communication, and we took every precaution to obtain accurate results. The effects of heat were carefully avoided, by covering over the troughs, on which the eye under examination rested, with a spherical double-shell of glass, having at least an inch of water between the walls.

The results we have arrived at are as follows:—

1. The action of light on the retina is to alter the amount of the electro-motive force to the extent of from 3 to 7 per cent of the total amount of the natural current.
2. A flash of light, lasting the fraction of a second, produces a marked effect.
3. A lighted match, held at a distance of four or five feet, is sufficient to produce an effect.
4. The light of a small gas flame enclosed in a lantern, and caused to pass through a globular glass jar (12 inches in diameter), filled with a solution of ammoniacal sulphate of copper or bichromate of potash, has also produced a change in the amount of the electro-motive power.
5. The action of light on the eye of the frog is as follows:—

When a diffuse light is allowed to impinge on the eye of the frog, after it has arrived at a tolerably stable condition, the natural electro-motive power is in the first place increased, then diminished; during the continuance of light, it is still slowly diminished to a point where it remains constant; and on the removal of light, there is a sudden increase of the electro-motive power nearly up to its original position. The alterations above referred to are variables, depending on the quality and intensity of the light employed, the position of the eyeball on the cushions, and modifications in the vitality of the tissues.

6. Similar experiments made with the eye of warm-blooded animals, placed on the cushions as rapidly as possible after the death of the animal, and under the same conditions, have never given us an initial positive variation, as we have above detailed in the case of the frog, but always a negative variation. The after inductive effect on the withdrawal of light occurs in the same way.

7. Many experiments have been made as to effect of light from different portions of the spectrum. This was accomplished by causing different portions of the spectrum of the oxy-hydrogen lime-light to impinge on the eye. All these observations tend to show that the greatest effect is produced by those parts of the spectrum that appear to consciousness to be the most luminous; namely, to yellow and the green.

8. Similarly, experiments made with light of varying intensity show that the physical effects we have observed vary in such manner as to correspond closely with the values that would result if the well-known law of Fechner was approximately true.

9. The method followed in these inquiries is a new method in physiological research, and by the employment of proper appliances, it may be greatly extended, not only with regard to vision, but also to the other senses.

SPONTANEOUS COMBUSTION.

MESSRS. C. PRICE and Co. have been attempting to draw the attention of Fire Offices to the danger resulting from the indiscriminate use of oils in factories, and in default of any response from these companies, they have appealed to the press. Our readers are of course aware that if oils are mixed with saw-dust, textile fibres, &c., so as to be exposed to the atmosphere in thin films, oxygen is rapidly absorbed, the temperature of the mass rises, and under favourable circumstances actual ignition may ensue. The effect varies greatly with the kind of oil used; some oils being exceedingly dangerous, whilst others may be regarded as practically safe. Hence the risk of fire in a factory must be influenced to a very considerable degree by the kind of oil used. Strange to say, this point is quite overlooked by Fire Offices, except as regards oils employed in the woollen manufacture. There a classification has been introduced, which, unfortunately, is far from being in harmony with facts. Olive oil is considered the least dangerous, mineral oils, pine, linseed, and rape, and their mixture the most so, whilst all other oils are supposed to hold an intermediate position. But according to chemists who have made this property of oils the subject of special examination—we may instance the late Professor Graham, Mr. J. Galletly, and Mr. Keates, consulting chemist to the Metropolitan Board of Works—olive oil ranks among the most dangerous oils, whilst the hydrocarbons, such as the mineral oils, are incapable of producing spontaneous combustion. Messrs. Price, therefore, call upon the Insurance Companies, in justice alike to themselves, and to the public, to have the relative heat-generating powers of the different commercial oils, determined by a commission of eminent chemists, and to apply the revised classification thus obtained to all establishments where oils are, for whatever purpose, brought in contact with fibrous or pulverulent organic matter. Such a classification would, however, still leave one thing to be desired.

A mill-owner might declare his intention of using only the safest oils, and be insured accordingly at the lowest rate, and all the time use, either fraudulently or in ignorance, mixtures of much more dangerous kinds. To prevent the possible consequences of such frauds or mistakes, Messrs. Price suggest that the Fire Offices should engage the services of chemists to test such oils, and stipulate for their admission to examine and test the lubricating mixtures, &c., used by parties who insure with them, just as Boiler Insurance Companies require admission for their inspecting engineer.

We need not say that we cordially agree with the suggestions of Messrs. Price. We consider that they have pointed out a very serious source of danger, which well deserves the attention of the public.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 4th, 1874.

Dr. ODLING, F.R.S., President, in the Chair.

THE names of the visitors having been announced, and the minutes of the previous meeting read and confirmed, Mr. H. H. B. Shepherd was formally admitted a Fellow of the Society.

The donations of books were then announced, after which the following names were read for the first time:—Messrs. Edwin Rider Cook, John Cox, and Henry John Cook.

For the third time—Messrs. James Bayne, Henry Bird, John Taylor Leighton, William M. Habinshaw, Percy Tarbutt, Robert Yates, Toraske H. Tono, Stephen Cooke,

and W. Sharman, who were then ballotted for and duly elected.

The first paper, "*On Dendritic Spots in Paper*," by H. ADRIAN, was read by the author. He said he could confirm Mr. Liversidge's observation that these markings were due to sulphide of copper with a nucleus of metallic copper or brass. They are rare in the better class of papers, but a cheap coarsely-finished blue-white paper, used extensively for account-books, exhibits them in large numbers. The spots seem to be formed from the metallic nuclei by the action of the antichlore used in the process of bleaching.

The President having thanked the author, Dr. MÜLLER said the spots were caused by particles of metal derived from the bed-plate of the machine used for tearing the rags becoming abraded by the steel wheel if the latter was lowered too much. Their being present to a greater extent in the cheaper papers was perhaps due to the sand, &c., in the coarse materials used, but the same effect sometimes occurred even in good papers. There were, moreover, other dendritic marks of an organic nature.

Mr. FRISWELL observed that large dendritic spots of reduced metallic silver were sometimes produced in photographic paper, on immersion in the silver-bath, by the action of these particles of metal.

The next paper, "*The Acidity of Normal Urine*," by J. RESCH, M.A., was read by the Secretary. The author finds that, on the gradual addition of hydrochloric acid to very dilute solutions of uric acid in weak soda, a precipitate is at first formed, which re-dissolves on agitation, but, on continuing the addition of the acid, it becomes permanent, consisting of uric acid without any urate. It is re-dissolved by hot solution of soda, and on adding acid, and cooling, it again comes down. From these results the author infers that, from solutions so dilute as urine, the uric acid may not crystallise out at all, except under favourable conditions, and this is due to its molecular constitution, and not to any increase in the acidity of the urine. With regard to the alkaline fermentation, the author's experiments lead him to believe that the decomposition is the result of a regular progressive change and not a sudden impulse, the fermentation being caused not by the mucus, but by the gradual oxidation of the uric acid.

The PRESIDENT remarked that the solubility of uric acid in water and in alkaline solutions was somewhat beside the question, which was as to its solubility in a solution containing urea. As to the oxidation of the uric acid being the cause of the decomposition of the urea, the evidence offered by the author was scarcely conclusive.

Mr. HARTLEY said he could not conceive how the decomposition could be effected by the oxidation, as in Pasteur's flasks, with the necks stopped with cotton-wool, or drawn out to a length of several feet, so as to exclude the entrance of any germs from the atmosphere, no change took place, although oxygen had free access.

A paper, "*On a Simple Method of Estimating Urea in Urine*," by Dr. RUSSELL and Mr. WEST, was read by the former. After referring to the processes of Davy, Knoss, and Huffner, he proceeded to describe the apparatus employed, which is a simple modification of that proposed by the last-mentioned chemist, and much less liable to derangement, enabling it to be used in the wards of hospitals. It consists of a tube about 9 in. long, with a bulb at the closed end, and a slight constriction above the bulb, capable of being closed with a long glass rod having a short piece of caoutchouc tube slipped over the end. The open end of the tube is fitted by means of a perforated cork into the bottom of a small pneumatic trough. 5 c.c. of the urine under examination are introduced into the bulb, whose capacity is about 12 c.c., washed in with a little water, and then closed by the glass rod. The tube is now filled up with a solution of sodium hypobromite prepared by dissolving 100 grms. of sodium hydrate in 250 c.c. of water, and adding 25 c.c. of bromine. The trough is filled with water, the glass rod is withdrawn,

and an inverted graduated tube, previously filled with water, is at once brought over the mouth of the laboratory-tube. The hypobromate now acts on the urea, liberating nitrogen, which passes into the graduated tube, and is there measured. If necessary, the reaction, which usually occupies about ten minutes, may be accelerated by gently heating the tube. It is found that the amount of nitrogen given off from a given weight of urea is about 8 per cent less than the theoretical, but, by a curious coincidence, the corrections, which would have to be made for the reduction in the volume of the gas for aqueous vapour and a temperature of 65° F., compensate for this; the variation caused by change of atmospheric pressure is so small that it may be disregarded. In practice, it is found advisable to graduate the tube so as at once to give either the percentage of urea present, or the number of grains per fluid ounce. [The apparatus above described was exhibited, and a practical illustration of the method given by Mr. West].

Dr. ODLING thanked the authors for their admirable paper, and especially for the practical illustration of the process. He hoped that the facilities afforded by the new preparation-room would induce authors of papers to give the Fellows of the Society the opportunity of witnessing the experimental phenomena with their own eyes.

In answer to questions put by the President and by Dr. Wright, Dr. RUSSELL said that the new method gave very satisfactory results when compared with the ordinary processes, and that the suppression of the 8 per cent of nitrogen did not vary with the temperature at which the experiment was made.

Mr. WEST said that Davy had observed that, in the decomposition of urea by the hypochlorites, the whole of the nitrogen was not given off, and Huffner had estimated the deficiency at 6 per cent. The sources of the excreted nitrogen were that produced by the tissue change in the body, and that derived directly from the food. Careful observations had been made on the latter, but the former had been somewhat neglected. The quantity, however, from the tissues seemed to be less than 200 grains, although the amount of urea excreted undoubtedly varied with the constitution of the individual.

A paper, "*On Ipomæic Acid*," by E. NEISON and J. BAYNE, was read by the former. The ipomæic acid of Mayer, prepared by acting with nitric acid on jalapine, has the formula $\text{HC}_5\text{H}_8\text{O}_2$, and, as its properties closely resemble those of sebacic acid, $\text{H}_2\text{C}_{10}\text{H}_{16}\text{O}_4$, the authors thought it possible they might be identical. They accordingly acted upon jalapine with nitric acid, and carefully purified the resulting acid. It was then found to have the same crystalline form as sebacic acid, and to melt at 126° to 127°, sebacic acid melting at 127° to 128°. Its solubility in water, moreover, was sensibly the same as that of sebacic acid, and the sodium, barium, lead, and silver salts of the two acids were precisely similar in appearance and properties. There can therefore be no doubt that ipomæic acid is identical with sebacic acid.

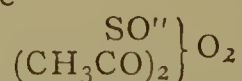
The President having thanked the authors for their interesting communication, Mr. G. S. JOHNSON read a paper "*On Certain Compounds of Albumin with the Acids*." The compound with nitric acid was obtained by placing white of egg in a hoop dialyser, and floating it upon the surface of very dilute nitric acid, density 1.0025. In about twenty-four hours it had changed to a semi-transparent jelly, which was soluble in boiling water, the solution gelatinising again on cooling. On neutralising with an alkali and heating, the albumin was precipitated, but the solution was not precipitated by corrosive sublimate, silver nitrate, or lead subacetate. Dried *in vacuo* the compound forms a hard, transparent, brittle mass, which contains 6.796 per cent of nitric acid; the formula, $\text{C}_{72}\text{H}_{112}\text{N}_{18}\text{SO}_{22} \cdot 2\text{HNO}_3$, requires 7.24 per cent. The corresponding compounds with hydrochloric acid, sulphuric acid, orthophosphoric and metaphosphoric acids were prepared in a similar way, and closely resemble the nitrate in properties and composition. The compounds with

citric, oxalic, tartaric, and acetic acids have also been prepared and examined. Besides the description of these substances—which only seem to be formed when albumin is dialysed in the manner described, and not when it is merely mixed with the requisite amount of acid,—this voluminous paper contains a detailed account of the action of a high temperature (150° to 200° C.) on white of egg and on the compounds of albumin with the acids.

The PRESIDENT said the Society was much indebted to Mr. Johnson for his investigation of the subject of these compounds of albumin. There was one point of special interest—namely, as to whether these were permanent when submitted to dialysis.

The Author replied that, after a sample of the hydrochlorate had gelatinised on the dialyser, he had floated it on distilled water for several days, and found, on analysis, that it still contained sensibly the same amount of hydrochloric acid.

Dr. D. TOMMASI then read a paper in French "*On Sulphite of Acetyl*." He prepares this compound by allowing acetyl chloride to fall drop by drop on dry lead sulphite, and, after allowing it to stand some time, distilling. Acetyl sulphite—



is a colourless liquid, of penetrating odour, which is decomposed by water, with disengagement of sulphurous anhydride and formation of acetic acid; sulphuric acid likewise attacks it with disengagement of sulphurous acid; and, with nitric acid, the action takes place with explosive violence.

There was also another paper by the same author, "*On a New Method of Preparing Toluene*." On heating benzyl chloride with ethyl alcohol, and then adding zinc-dust in small quantities at a time, a reaction takes place, with evolution of gas. By distillation, a liquid is obtained which, on adding water, leaves a colourless oil, insoluble in the latter, and boiling at 111° to 112° C. This was found on analysis to have the formula C_7H_8 , and an examination of its properties proved it to be toluene. The author believes that in this reaction zinc benzyl is first formed, which, in the presence of the water contained in the alcohol, is decomposed into zinc hydrate and toluene.

The last paper, a "*Note on New Zealand Kauri Gum*," by M. M. P. MUIR, was read by the Secretary. After describing the physical properties of this gum resin, obtained from the *Dammara australis*, the author states that a portion is soluble in water, and about 52 per cent in alcohol, the latter containing traces of benzoic and succinic acids. It is soluble in concentrated sulphuric acid, and is violently attacked by nitric acid. By dry distillation, an oil was obtained which, on fractionation, yielded a liquid boiling between 155° and 165° C., and having the composition $\text{C}_{10}\text{H}_{20}\text{O}_7$.

The meeting was finally adjourned at a late hour until Thursday, June 18, when the following communications will be read:—(1) "*On Iso-Dinaphthyl*," by W. Smith. (2) "*Communications from the Laboratory of the London Institution*," by Dr. H. E. Armstrong. (3) "*On the Products of the Decomposition of Castor Oil; No. III., On the Decomposition by Excess of Alkaline Hydrate*," by E. Neison. (4) "*On the Restitution of Burnt Steel*," by J. L. Davies. (5) "*On Suberone*," by Dr. Schorlemmer. (6) "*On the Action of Nitrosyl Chloride on Phenol*," by Dr. W. A. Tilden. (7) "*On an Apparatus for the Determination of Carbonic Anhydride and Moisture*," by Dr. D. Tommasi, as also (8) "*The Determination of Ozone in the Presence of Chlorine and Nitrous Acid*," and (9) "*Constitution of Urea*."

Certain New Derivatives of Brominised Anilines.—L. Remmers.—The author has obtained and examined nitrobrom-acetanilid, bromphenylen-diamin, ethenylbromphenylen-diamin, dibrom-acetanilid, nitro-dibrom-acetanilid, tribrom-diacetanilid, and nitro-tribrom-mono-acetanilid.

NOTICES OF BOOKS.

The Practical Assayer. By OLIVER NORTH. London: Chatto and Windus.

MR. NORTH'S object has been, he informs us, to provide a concise and clear account of the best and quickest way of assaying the principal metals." He thinks "most works on this subject mix up the province of the analytical chemist too much with that of the assayer, whereas the two are totally distinct." We should like to see the author's definition of assaying. He evidently does not restrict the use of the term to determinations of the dry method, as was formerly usual. Nor does he limit it to the estimation of some one constituent of a complex body on which its commercial value mainly depends.

In addition to the metallic ores, he includes in his scope sulphur, nitrate of soda, and guano. On what principle coal, potash-salt-petre, borax, phosphatic minerals, &c., &c., are excluded, we scarcely see. We should pronounce assaying merely a branch of analytical chemistry, comprising processes capable of rapid execution, and serving to indicate the value of commercial substances with a degree of accuracy sufficient for ordinary practical purposes. It must further be noticed that the more accuracy comes to be insisted on, the more the assayer becomes an analytical chemist. Mr. North goes on to say: "The very first chemist of the day might easily be far inferior to a good assayer in estimating the exact value of an ore." Doubtless, keep a man constantly performing one operation, or one limited set of operations, and, unless grossly careless or incapable, he acquires a special expertness, which persons whose practice is more varied cannot expect to rival. The author further tells us that he has left out some "better processes than those given," which scarcely agrees with his intention of explaining the "best way" of assaying ores.

In speaking of copper, we are glad to find that he rejects altogether the Cornish assay. In place of it, he gives the Chilian method by precipitation in the metallic state by means of iron, and the volumetric process with cyanide of potassium. The Mansfeld process (Dr. Steinbeck's) is omitted. All procedures for the determination of lead and tin by the moist way are rejected. It is to be regretted that the author has not paid more attention to the correct use of language. Thus, on page 117, we read: "The ore (lead) must be got through a 60 sieve, and, as in the case of tin-ore, carefully mixed up to secure a homogeneous sample, which very often causes great errors." Mr. North meant to say the very opposite.

The assay of cobalt and nickel does not strike us as perfectly trustworthy. These metals cannot, so far, be accurately determined without full time is allowed for the operation.

In speaking of guano, the author directs the determination of the phosphate by the addition of ammonia to the acid solution of the entire ash. Sometimes, however, it happens that the phosphate present is a mixture of the tri-calcic and the di-calcic salts. In this case, the amount of lime present may not suffice to carry down all the phosphoric acid present on the addition of ammonia. In this case, a further deposit will be formed on adding a little solution of chloride of calcium to the filtrate. It must also be remembered that, if this process is applied to the ash without previous extraction with water, any phosphoric acid present in combination with alkali will be determined as if combined with lime; and if a special determination of the acids and bases soluble in water, be subsequently made, it may appear in the results twice over.

The appendix on copper-smelting in Chili is exceedingly interesting, and should be read by all who intend investing in Chilian mines. We learn that a lawyer was actually sent out to manage the smelting works of an English company at Guayacan. A collapse was the natural consequence.

Experimental Researches on the Causes and Nature of Catarrhus Æstivus (Hay-fever or Hay-asthma). By C. H. BLACKLEY, M.R.C.S.E. London: Baillière, Tindall, and Cox, King William Street, Strand.

HAY-FEVER is in many respects a remarkable disease. It first appeared, or, at least, was first recognised, in England about the year 1819, and is still more prevalent in this country than in any other part of the world. The disease is next most frequent in Germany, whilst France, Belgium, Switzerland, Scotland, Italy, Russia, and Ireland follow in the order in which they stand. Climate, therefore, can play no prominent part as a predisposing cause, or Ireland would certainly stand nearer England in the list than either Italy or Russia. Out of a total number of 152 patients whose parentage was ascertained, 81 were found to have been of English parents (natives of England proper) whilst of the remainder 36 were found to have been born of German parents, leaving only 35 whose parents were natives of other countries. Only one patient was born of Irish parents, thus showing that race seems to have a more potent influence in producing a predisposition to the disease than mere geographical position. Another remarkable fact is that disease, if not aristocratic, is almost peculiar to the educated classes, and seems to become more common in proportion to the spread of mental culture, and the intensity of intellectual labour.

Various agents have been supposed to be the exciting cause, such as the first heats of summer, dust, ozone, the odours of flowers, the pollen of all blossoms and especially of grasses. The author has devoted much time to experiment and observation on these reputed causes, and he decides on what appears sound evidence that the cause of this affection is pollen. He appends a curious table of curves showing the number of pollen grains collected in 24 hours on a surface of one square centimetre from May 28th to August 1st, 1866. The highest number, 880, was reached on June 28. Temperature and rain-fall materially affect the amount of pollen floating in the atmosphere, and hence must indirectly influence the frequency and severity of the disease. In perfect harmony with the pollen-theory, hay-fever was found least common in those localities where pollen is least likely to be plentiful, as in the centre of large cities, on the sea-shore, and on high-lying districts where the land is chiefly devoted to pasturage. By means of kites he succeeded in ascertaining the amount of pollen suspended in the higher regions of the air, as compared with the quantity found simultaneously at, or near the surface of, the earth. The result was that at heights of 1500 feet pollen was found more abundant than near the ground. One of these comparative experiments was tried at Filey in July 1870, during an easterly wind. The glass sent up by a kite to the height of 1000 feet had a deposit of 80 pollen grains upon it, whilst one exposed at the sea-level, "showed no pollen or any solid matter whatever." The author had opportunity to make a highly suggestive observation which may possibly bear upon the causes of diseases more important than hay-fever. Germs and spores of other kinds were found, generally in much larger quantity than pollen. "If," remarks the author, "many of these should resemble pollen in its capacity for absorbing water, and discharging granular matter under the influence of moisture, we may have a form of finely divided vegetable and animal matter thrown into the air, which the best modern instruments might fail to discover the nature and origin of, but which might, nevertheless, be a powerful cause of disease."

There evidently appears here room, or rather necessity, for a prolonged and laborious series of experiment and observation. What is the nature of the germs and spores detected? How are they affected, in kind or in quantity, by the circumstances of altitude, climate, season, and temperature? Can their appearance in unusual numbers, or in any particular kind, be connected with the prevalence of any given disease? These are questions not unworthy the attention of epidemiologists. Meantime, other questions are also suggested, less practically important, but

highly interesting to the scientific enquirer. How is it that germs and spores are more numerous in comparatively elevated regions of the atmosphere than near the earth's surface, and, in consequence, near their origin? What is the nature of the force which carries up the germs and keeps them aloft? Why and when do they re-descend?

Mr. Blackley may be fairly congratulated on having produced a work which is not merely a valuable contribution to our medical literature, but which may be read with interest by many scientific men not connected with the profession.

CORRESPONDENCE.

THE SEWAGE QUESTION.

To the Editor of the Chemical News.

SIR,—As I was unable to be present at Prof. Corfield's lecture on "The Sewage Question," perhaps you will allow me to make some remarks on the report of it in the CHEMICAL NEWS of last week.

Prof. Corfield, in speaking of dry conservancy, still refers to earth and ashes as the only deodorants, and unfairly criticises *all* dry systems because he appears to think these must be based on such clumsy and inefficient substances. Now one of the important advantages of a dry carrier over any wet system is that, whilst the latter necessarily confines us to the use of water, the former affords the chemist a large choice of deodorisers, and of these, as I have repeatedly pointed out, earth and ashes are certainly the worst.

The lecturer has not hit the true reason why the manure from earth-closets is so valueless. I fully agree with Drs. Frankland, Gilbert, and Voelcker as to the poverty of this manure; numerous analyses have led me to the same conclusion. A manure after three uses in the earth-closet ought to contain at least five times as much nitrogen as it does. The fact is that, while charcoal, for instance, preserves an organic nitrogenous substance, earth decomposes it.

In a paper which will shortly be brought before the Chemical Society, I shall clearly show that mixtures of nitrogenous organic matter with earth rapidly lose nitrogen, that this loss is continuous, and that there is no trace of nitrification. As to how this nitrogen goes off, there is much yet to learn, and a prolonged investigation has not yet enabled me to speak positively, but of the loss there is no doubt. The real reason why the sewage of midden towns differs so little from that of water-closet towns is fully explained in one of my papers on the "Sewage Question" (CHEMICAL NEWS, vol. xxii., p. 302).

Considering the lecture was "On the Sewage Question from a Chemical Point of View," and delivered to the "Chemical Society," it is remarkable for total absence of all reference to purely chemical methods of dealing with the question. He ought not either to be very proud of the discussion from "a chemical point of view," when one eminent agricultural chemist says "the best way is to send it into the sea," and another says "that it could never be made profitable." Do these learned gentlemen forget that hundreds of towns can never hope to get their sewage to the sea, and that in civilised London every scrap of animal manure, other than human and much less valuable, is carefully collected and "profitably" kept out of the sewers?—I am, &c.,

E. C. C. STANFORD, F.C.S.

Carruth, Bridge of Neir, N.B.,
June 6, 1874.

COMMERCIAL ANALYSES.

To the Editor of the Chemical News.

SIR,—You have frequently upheld the propriety of re-turning the results of analyses in such a form as to

represent the real chemical value of the article analysed. I feel it right to call the attention of analytical chemists to the fact that the estimation of acetic acid in acetate of lime is frequently made by simple ignition of the commercial salt, and the acid calculated from the calcium carbonate, with subtraction of the lime sulphate present. These results are very confusing to commercial men when compared with the amounts of acetic acid obtained by distillation with hydric phosphate and titration in the usual way. Here are the figures obtained by the examination of three samples—

		Acetate of Lime, per cent.	
		By Distillation.	By Ignition.
No. 1	.. ..	70.17	85.47
No. 2	.. ..	69.98	85.30
No. 3	.. ..	32.29	73.78

The indirect method I regret to say appears to be employed by some chemists of established reputation. It is obviously incorrect, and it is unjust to the conscientious worker who is at the trouble of making the more laborious analysis. As a rough method, the ignition may have its value, but, if it be employed to certify a parcel for sale, the certificate should also state the method used.—I am, &c.,

WILLIAM BAKER,
Assoc. Royal School of Mines Lond.

County Analyst's Office,
46, High Street, Sheffield,
June 9, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, April 20, 1874.

Letter Relative to a Calculation of Pouillet on the Cooling of the Solar Mass.—M. Faye.—This calculation, tacitly but unwarrantably, assumed that the mass is not susceptible of contraction. If the mass contracts, even by a quantity imperceptible by us (less than 28 metres per annum), the thermal effect must compensate, in great part, that of exterior radiation; a state of things which will last so long as the alimentation of the photosphere continues at the expense of the central layers. An external source of alimentation is superfluous; the formation of the sun, his enormous mass, and the mode of maintenance of his photosphere sufficiently explain the actual radiation, so remarkable in constancy and intensity.

Observations on M. Crocé Spinelli's Communication on Bands of Aqueous Vapour in the Solar Spectrum.—P. Secchi.—The writer says he had never affirmed that, in the solar spectrum in general, one might see the lines of aqueous vapour, but merely that in some of the solar spots there were some bands coincident with those of aqueous vapour. Probably in the sun's high general temperature water would not form, but from lowering of temperature through dilatation of gases in eruption (at a spot) it might. And the observations of M. Crocé Spinelli do not invalidate this, for he did not specially observe the spots.

Collimator Level and its Employment for a Horizon in Fog.—M. Goulier.—This new instrument consists of a pendulum suspended by a double joint, and carrying a collimator formed of a small tube, hermetically closed at one end by ground glass, and at the other by a convergent lens, 6 m.m. diameter and 18 m.m. focus. At the principal focus of the lens is a diaphragm pierced with a hole 2 m.m. diameter, and with a black silk thread across it. When the pendulum is at rest, the plane passing through the thread and the optical centre of the lens is a horizon-

tal one. Thus the eye, looking through the lens, sees a dark line tracing the horizontal plane of the instrument. The advantages urged are—(1) The instrument is small. (2) It can be readily used by anyone without previous instruction. (3) It is invariable. It might be used by seamen (being fitted to a sextant so that one should see the collimator through the transparent part of the small mirror) for taking the height of stars when the horizon of the sea is not visible.

An Orometric Dial Suitable Especially for Pocket Barometers.—M. Goulier.—The author makes a circular scale within that expressing the millimetres of mercury; and on it one reads, opposite the pressures observed at stations A and B, two orometric numbers, which express the depth of these stations below the same level. The difference of these two numbers gives the difference of level at the two stations. Two specimen dials are given, one for average, and one for lofty mountains.

Absorption of Oxygen and Emission of Carbonic Acid by Leaves Kept in Darkness.—MM. Deherain and Moisson. (1) The quantity of CO₂ emitted increases with rise of temperature (as previously observed). At 7° 100 grms. of tobacco leaves gave in ten hours 0.031 gr. of CO₂; they gave 0.193 gr. at 18°, and 1.132 gr. at 41°. The increase varies with the species. It is greater, e.g., with *Pinus pinaster* than with *Ficus elastica*. (2) The quantity of CO₂ emitted is comparable to that furnished by cold-blooded animals. Thus, taking Regnault and Reiset's data, frogs give in respiration weights of CO₂ much less than leaves of tobacco, mustard, or sorrel. At 15° the respiratory activity of silkworms is comparable to that of cuducous leaves observed at 30°, but notably greater than they manifest at 15° to 20°. (3) Leaves kept in the dark absorb more O than they emit CO₂. For example, 30 grms. of leaves of *Pinus pinaster* absorbed in twenty-four hours 7.7 c.c. of O, and emitted only 3.9 c.c. of CO₂. The effect is most sensible at low temperatures. The branches of some fatty plants (*Agave*, *Opuntia*) sometimes absorb O without emitting CO₂. The O fixed is utilised for formation of vegetable acids. (4) Leaves continue to emit CO₂ in an atmosphere deprived of O. The resistance to asphyxia is various. Pine leaves continue four or five days to emit CO₂, while those of tobacco, sorrel, *Ficus elastica*, *Begonia*, soon wither. (5) Hypothesis on the physiological utility of the internal combustion produced in leaves. Obscure heat is peculiarly favourable to energy of respiration, and there seems to be, between rapidity of growth and energy of respiration, a connection which may be understood if we suppose that a certain quantity of heat must be called into action in order that the immediate principles may form. The internal combustion, shown by absorption of O and emission of CO₂, is the origin of a part of the heat necessary to elaboration of new immediate principles.

New Method of Measuring the Velocity of Light.—M. Burgue.—Consider a disc turning very rapidly about its axis, and at each turn illuminated by an intermittent and instantaneous light. A small dark radial line, *a*, on the disc will seem at rest like the disc itself. Withdraw the source of light to a distance; the time the light takes to come and illuminate the disc is now greater, and the line is displaced to a position *a'*, forming with *a* a certain angle, *aOa'*, which will accordingly measure the time of the light's passage a given distance. [This note was submitted to M. Fizeau for consideration.]

Facts Relative to the Vibration of Air in Sounding Tubes.—M. Gripon.—A mass of air which vibrates separately, in unison with a pipe placed at some distance and opposite to the open extremity of the pipe, raises the sound as a vibrating membrane does, but the alteration is less. Representing by 1 the number of vibrations of the original sound, the altered sound is represented by 1.008, if the sounding case of a diapason *do*³ be placed before a pipe of the same pitch, and by 1.004 if you operate with *do*⁴. The sound of the pipe falls if the air-case be

graver than it; it rises if the case be more acute. (Various related facts are given.)

New Thermo-electric Pile.—M. Clamond.—The author has been improving his apparatus. He found in it a considerable increase of resistance, and this was due to two causes—(1) Oxidation of the contacts of the polar plates with the crystallised bar under the influence of heat; and (2) splitting of the bar and separation of its different parts in planes perpendicular to its length. (His mode of remedying these evils is described.) In making his couple he uses an alloy of zinc and antimony, and plates of iron as armatures. The bars are collected in crowns of ten bars each, superposed and separated by washers of amianthus, and coupled for tension. The whole forms a cylinder, the interior of which is luted with amianthus, and heated by means of a pipe of refractory earth pierced with holes. The gas mixed with air burns in the annular space between the tube and the bars. The entire surface of the crowns of the pile is 35 square decimetres. The consumption of gas is controlled by M. Girond's regulator (referred to in next note). Thus arranged, the pile will work whole months without requiring attention, giving a current absolutely constant. The model shown consumed 170 litres, that is, about 5 centimes of gas in the hour, and deposited 20 grms. of copper, which makes the expense of gas per kilogram of copper deposited 2 francs 50 cents. M. Clamond has made models of various size; the quantity of electricity increases proportionally to the size of the pieces.

Regulator of Volume for Currents of Gas.—M. Girond.—The problem is to render the volume flow at a given point of a gaseous current independent of variations of pressure of the gas, and of the size of the final orifice of outflow. [The author's mode of solving it cannot well be understood without figures.]

Movement Produced in the Stamens of Mahonia and Berberis; its Anatomical Conditions.—M. Heckel.—The contractile cells of the two faces of the stamen are mobile, not by its envelope, probably, but by its granular protoplasm, which contracts and induces the retreat of the enveloping membrane. There is antagonism of the dorsal and the anterior cells. The former contract under the influence of irritation, and the movement of the organ is produced; the latter are stretched by the contraction of the fibre and elongated, but they tend to react and return to their normal state, which is that of contraction. Thus the stamen gradually returns to its position.

Direction of the Wind in the Storm of April 13, 1874.—M. Chapelas.—He noted that morning a barometric pressure of 742 m.m., and a direction of wind and clouds S.S.W. to S.W. Next morning the wind and clouds had the opposite direction, N.E. N.N.E. The barometer rose 4 m.m., and continued to rise till the 19th.

Gen. Morin presented the first volume of Tome iv. of the "Revue D'Artillerie," containing, among other things, a highly interesting *resume* of an inquiry instituted into the qualities and faults of the artillery *matériel* employed in the war of 1870-71.

Formation of Certain Crystalline Substances in Capillary Spaces.—M. Becquerel. (Tenth memoir.)—The author has previously succeeded in obtaining crystalline alumina with three equivalents of water, $\text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$, blue crystalline hydrate of copper, and the crystallised oxides of zinc and lead, hydrated silicate of copper in double refracting crystalline needles, &c. Having recently resumed his experiments, he now announces the formation of fluoride of calcium, crystalline aluminate of copper, blue silicate of copper, $\text{CuO} \cdot \text{SiO}_2 \cdot 2\text{H}_2\text{O}$, aluminate of magnesia in crystalline needles, and differing from spinel only in containing no water, and a variety of other crystalline minerals.

New Researches on the Cyanogen Series.—M. Berthelot.—An investigation into the amount of heat developed in the formation of the double cyanides.

Heat of Formation of the Cyanic Compounds from their Elements.—M. Berthelot.—A table, incapable of abstraction.

Part Played by Salts in the Action of Drinking-Waters upon Lead.—M. Fordos.—The salts examined were sulphate of soda, chloride of sodium, nitrates of potash and ammonia, and a saturated solution of sulphate of lime. In all cases the lead was attacked, and traces of the metal entered into solution.

Preservation of Wood.—M. Hubert.—The author proposes to coat the wood with oxide of iron, by driving into it abundance of long slender nails with broad flat heads.

Tetraiodide of Carbon.—G. Gustavson.—This substance forms deep red crystals of an octohedral form, belonging to the regular system. Its specific gravity at 20.2° is 4.32.

New Researches on Black Phosphorus.—M. Blondlot.—This paper has been already noticed in the CHEMICAL NEWS.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin,
No. 4, March 9, 1874.

On Nitro-Anthracen.—E. Schmidt.—The author finds that the mono-nitro-anthracen of Bolley and Tuchschildt is not a pure nitro-derivative of anthracen, but a double compound of dinitro-anthrachinon and chrysen. He is also unable to confirm the results of Phipson, since on treating anthracen with nitric acid, he obtained, instead of an isolable nitro-anthracen, merely a mixture of anthrachinon and dinitro-anthrachinon.

Preparation of Pure Phenanthren.—E. Schmidt.—If mixtures of hydrocarbons containing phenanthren are dissolved in alcohol of 80 to 85 per cent, and the filtrate is boiled for some time with an amount of nitric acid equivalent to the hydrocarbon, and allowed to cool, all the anthracen separates out, first as anthrachinon and dinitro-anthrachinon, in the form of a resinous cake. On further cooling the liquid congeals to a crystalline paste of unchanged phenanthren.

Influence of the Position of Oxygen upon the Boiling-Point.—Alex. Maumann.—The author concludes that "in metamerous bodies of like chemical character and corresponding structure, the more the oxygen combined in a similar manner advances towards the centre of the chain of atoms, the lower falls the boiling-point."

Action of Sulphuretted Hydrogen upon Chloral Hydrate.—G. Wyss.—The author treated chloral hydrate with sulphuretted hydrogen, and obtained a crystalline body, soluble in alcohol and ether, to which he assigns the formula $\text{C}_4\text{H}_4\text{Cl}_6\text{O}_2\text{S}$.

Isomeric Dinitro-benzoic Acids, and their Connection with Phenylene-diamins.—C. Wurster and G. Ambuhl.—The authors have succeeded in converting ordinary diamido-benzoic acid into phenylene-diamin.

Communications by A. P. M. Franchimont.—Remarks on the action of pentachloride of phosphorus upon alcoholate of sodium; on anhydrous citric acid, and on the preparation of malonic acid.

Action of Nitrous Acid upon Ethylaniline.—Peter Griess.—The author finds that the chief product of the reaction is $\text{C}_8\text{H}_{10}\text{N}_2\text{O}$, a new compound.

On Sebacylic Acid.—O. M. Witt.—A preliminary notice on the salts of this acid, especially the cobalt compound.

Mutual Behaviour of Phosphate and Carbonate of Lime at Elevated Temperatures.—F. Wibel.—The author finds—(1) That the pyro and ortho phosphates, as well as the apatite compounds, when heated with carbonate of lime, are decomposed in such a manner that the carbonate gives up to the phosphate a part of its lime, which cannot be re-converted into carbonate by means of car-

bonate of ammonia. (2) The extent of this decomposition depends on the constitution of the phosphate, the proportions of the mixture, the intensity and duration of the heat, and on the presence of organic matter. It is notably increased by the two latter points. (3) The process of decomposition depends, in pyrophosphates, on the tendency to pass into neutral ortho-phosphate; in ortho-phosphates, on the disposition to form basic salts; and in the apatites, on the substitution of lime for chloride of calcium. (4) In the analysis of bodies containing phosphate and carbonate of lime along with organic matter, the determination of the latter is erroneous when calculated from the loss of weight on ignition, after treatment with carbonate of ammonia. The amount will be found increased by the carbonic acid which is incapable of restoration. (5) In all mixtures of carbonates and phosphates carbonic acid can only be determined previously to ignition. In the ignited mass it will be found too low, even after treatment with carbonate of ammonia. These results are of great importance as regards the analysis of bone-ash, and the constitution of bone-earth.

Nitro Compounds of the Allyl Series.—E. Brackebusch.—The author has examined nitro-propylen, sodium- and potassium-nitro-propylen, allylamin, and nitrite of allyl.

Communications from the Laboratory of the University of Freiburg.—Ad. Claus.—These communications consist of a lengthy paper on the uric acid group, a notice on the thioprussamic acids, and on sulphurea.

Formation of Methyl-hydantoic Acid.—E. Baumann.—The author finds that methyl-hydantoic acid cannot be formed by the action of urea upon sarcosin introduced into the animal organism.

Splitting up of Dibenzyl-disulpho Acid.—R. Kade.—If the potash salt of this acid is fused at a low temperature there is formed oxydibenzyl-sulpho acid; at a higher temperature dioxy-dibenzyl is obtained.

Isomeric Nitro-aceto-naphthalids.—C. Liebermann and A. Dittler.—This paper is not suited for abstraction.

Action of Nitrous Acid upon Phenols.—C. Liebermann.—If orcin is dissolved in concentrated sulphuric acid, and if small quantities of pulverised nitrite of potash are gradually added, the solution turns purple. Water throws down red flakes, which re-dissolve in alkalis with a cherry-red colour, and display a vermillion fluorescence. The colour thus obtained is not orcein, but is in certain respects analogous to the colouring matters obtained some years ago from resorcin by Weselsky. Sulphurous acid containing nitrous acid forms colouring matters with most phenols. To concentrated sulphuric acid, in a stoppered bottle, 6 per cent of nitrite of potash was added, and the absorption of the vapours promoted by shaking. The various phenols require respectively a somewhat different treatment with this reagent. Some must be treated in the solid state with several volumes of the reagent, whilst others are added to it as concentrated aqueous or sulphuric solutions. A concentrated aqueous solution of resorcin is immediately turned by this reagent a fine blue. If added to phenol the mixture becomes hot, and assumes first a brown, then a green, and in a few moments a royal blue colour. If the blue solution is poured into water, with due precautions to prevent a rise of temperature, the colouring matter is deposited in reddish brown flakes, which re-dissolve in alkalis with a rich blue colour.

A Lactic Acid of the Allyl Series.—A. Pinner.—The author has obtained acrylolic acid, which contains two equivalents less hydrogen than the lactic acids, $C_3H_6O_3$.

Oxidation Products of Isobutylic Alcohol, and on the Trichloroacetone Formed from the so-called Isobutylic Aldehyd.—G. Kraemer.—A controversial essay in reference to the paper by Barbaglia, vi., 910.

No. 5, March 23.

Nature of Bleaching Lime.—C. Gœpner.—A critique on Schorlemmer's paper (*Berichte*, vi., p. 1509). The

author questions the scientific value of Schorlemmer's method of demonstrating the presence of hypochlorous acid, considering the difficulty of detecting chlorine along with that acid.

Ammonia Soda Process.—A. Bauer.—The decomposition of bicarbonate of ammonia by chloride of sodium is incomplete, the loss of salt amounting to about one-third of the total weight employed. The author seeks the cause of this in the fact that the carbonate and bicarbonate of soda are decomposed in contact with sal-ammoniac, forming carbonates of ammonia and common salt. This transposition takes place under a great variety of circumstances.

Determination of Acetylen in Gaseous Mixtures, and the Composition of Acetylen Copper.—R. Blochmann.—The author finds that in the analysis of coal-gas it is not advisable to attempt the determination of acetylen according to Bunsen's gasometric methods. Berthelot and Landolt determine acetylen directly by passing it through an ammoniacal solution of copper, decomposing the precipitate obtained, and determining the volume of acetylen set free.

Formation of Anthracen by Heating Chloride of Benzyl with Water.—Th. Zincke.—Anthracen is apparently a product of the splitting up of a higher hydrocarbon, nC_7H_6 .

Transformation of the Diazonitro-Benzols into Nitrophenols.—R. Fittig.—The nitric-diazo compound from nitro-acetanilid passes into nitrophenol on boiling with water.

Alcoholic Fermentation.—Oscar Brefeld.—The author concludes that—(1) Alcohol yeast, like all other plants, requires for its development and increase the co-operation of free oxygen. (2) If air and free oxygen are excluded, the yeast cannot grow. These two facts overturn the theories of Pasteur on fermentation. (3) Yeast, in contradistinction to all other plants, when in solutions where its growth is possible, has a great affinity for free oxygen. It can completely extract free oxygen mixed with 6000 volumes of carbonic acid. (4) *Mucor racemosus* has the same property, and excites alcoholic fermentation in a saccharine solution. (5) Growth and increase of yeast may take place without fermentation, and, again, fermentation without growth of yeast. The carbonic acid thrown off in fermentation is remarkable for its purity. (6) In suitable solutions, exposed to the air, growth of the yeast plant and fermentation occur simultaneously in different parts of the liquid. (7) Fermentation is the expression of an abnormal incomplete vital process, in which all the bodies required for the nutrition of the yeast do not simultaneously and harmoniously co-operate. These results will prove of great technological interest.

A Universal Burner.—R. Muencke.—A useful piece of apparatus, which we cannot describe without the accompanying illustrations. It is manufactured by Warmbrunn and Quility, of Berlin.

Communications from the Laboratory of the University of Wurzburg.—J. Wislicenus.—Dr. Goldenberg has been engaged with an examination of certain derivatives of benzoïn. Bonné and Goldenberg have examined a silver compound of biuret. Carl Zimmermann has prepared certain novel silver compounds of melamin, and has also studied the constitution of phosphoro-ethylester. Kessel has obtained a secondary normal butyl-ether by the mutual action of pure ethylen oxichloride and zinc diethyl. Zuckschwerdt has studied the action of nascent hydrogen upon dinitro-ethylic acid, and has extended his investigation to the addition-product of sulphurous acid and zinc ethyl. C. Forster has obtained mercurid-phenyl-ammon-chloride, and has examined its action upon substituted thio-ureas. Valerius Hemilian has endeavoured to decide the constitution of the isomeric crotonic acids.

Combinations of Thallium with Alcohol Radicals.—F. C. Hartwig.—The author has obtained the diethyl-

chloride of thallium, the sulphate, phosphate, nitrate, acetate of thallium-diethyl; the iodide, hydroxide, and chloride of thallium.

Preparation of Thallium-Triethyl.—L. Carius and C. Frommüller.—A continuation of the researches described in the foregoing paper.

Aluminium Chloride of Platinum.—A. Welkow.—The compound consists of—

Aluminium	3.95
Platinum	26.29
Chlorine	33.33
Water	36.58

100.15

It shows no analogy with the glucino-chloride of platinum, an additional proof that glucinum and aluminium are essentially distinct in their chemical nature.

Certain Derivatives of α - and β -Diamido-naphthalin.—A. De Aguilar.—A lengthy paper, not adapted for abstraction.

Synthesis of Tetra-methyl-succinic Acid.—C. Hell and A. Wittekind.—The authors caused monobrom-isobutyric-ethylester to act upon finely divided silver. The properties of the acid thus obtained differ decidedly from those of ordinary suberic acid.

Synthetic Cymol obtained from Normal Bromide of Propyl and Crystalline Bromtoluol.—F. Pittica.—The author considers that his experiments have proved the presence of normal propyl in the mutually identical cymols.

Method for obtaining Bases Free from Oxygen.—O. Wallach.—The author has examined the behaviour of PCl_5 with oxygenised amides.

Constitution of the Substituted Phenols.—Jul. Post.—A very long paper, which cannot be usefully abstracted.

Promiscuous Communications.—M. P. v. Wilde.—The author treats of the preparation of acetylen, the action of hydrogen upon acetylen and ethylen in contact with platinum-black, and gives a preliminary notice on the action of electric currents upon gases and gaseous mixtures.

Reimann's Farber Zeitung, No. 11, 1874.

This number contains receipts for a logwood-blue as substitute for vat-blues on wool and cloth; a blue for topping piece-goods previously grounded with blue; a logwood-blue on a white ground; a blue for topping wool already dyed blue; a continuation of the article on dyeing and dressing plushes; a black on mixed woollen and silk goods; a black for felt hats; a topping for vat-blue linen; a black finish with ox-blood on mixed woollen and cotton goods; a nacarat and a claret on wool.

White-lead is recommended, in preference to chalk, for adulterating oil-colours for pigment-styles.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the treatment of waste or refuse animal or nitrogenous matters for the purpose of producing fertilising substances or artificial manures. William Crookes, F.R.S., Morningside Road, Regent's Park, Middlesex. August 23, 1873.—No. 2790. The object of this invention is to convert waste or refuse nitrogenous matters into artificial manures or fertilising substances. The animal or nitrogenous matters to which the invention is applicable consist of animal matters, such as woollen rags, wool-waste, &c.; wet putrescible matters, such as fish, either fresh or stale, or such as is unfit for food, and liquid or semi-liquid matters not so nitrogenous as the before-mentioned substances.

Improved means or method of treating and clarifying impure or waste water from fulling-mills, scouring-mills or scouring processes, dye-houses, sewage, or other impure waters. Rupert Goodall, machinery agent, Armley, Leeds. August 23.—No. 2791. To the water to be clarified is added fine ashes and slacked lime, and the whole is stirred until the water is "cracked;" then add sesqui-persulphate of iron in

solution (obtained from the mother-liquor of copperas beds) and saturated solution of sulphate of magnesia or Epsom salts, and the whole is again stirred or agitated, whereon the solid matters and impurities and discolourations are separated and precipitated. The above chemicals are used in the proportions and manner specified.

A new process for the production of soda and potash from their respective haloid salts by the direct wet method. Charles Denton Abel, Southampton Buildings, Chancery Lane, Middlesex. (A communication from Hector de Groussilliers and George Siemens, Berlin). August 28, 1873.—No. 2838. This invention consists in producing soda and potash from their haloid salts by admixture therewith of carbonate of ammonia dissolved in strong alcohol or wood-spirit. The salt is introduced, together with a solution of mono-carbonate of ammonia in alcohol, into a closed vessel lined with lead, which is heated, whereupon the compound will be transformed into alkaline carbonate, and chloride of ammonium, of which the former is precipitated, while the latter is retained in solution. The solution is then drawn off, and the alkaline carbonate is washed with spirit, and dried. For manufacturing on a large scale, the salt is placed in a vessel with perforated double bottom, and a heated solution of carbonate of ammonia in alcohol is then forced through the salt until no more chloride of ammonium is found in the solution issuing from the vessel.

Improvements in the recovery of alkali from the liquid in which esparto, wood, straw, or other material has been boiled. David Adam Fyfe and William Hadfield Bowers, Manchester. September 1, 1873.—No. 2873. The inventors absorb waste alkaline liquors with sawdust or other vegetable substances. The sawdust is then dried, and placed in or fed into a retort. The acid, tar, gas, and other products are collected, and the alkali is recovered from the charcoal or from the ash resulting from the combustion of the charcoal.

Improvements in the method of, and apparatus for, separating free sulphur from substances containing it. Samuel Henry Johnson, manufacturing chemist, Lea Bank Works, Warton Road, Stratford, Essex. September 2, 1873.—No. 2891. This Provisional Specification describes the separation of free sulphur from other substances by the use of bisulphide or any simple solvent; also an extractor provided with a filter.

An improved mode of separating and obtaining gold, silver, and other metals from their ores. George Haseltine, LL.D., Southampton Buildings, London. (A communication from Solomon William Kirk, chemist, Philadelphia, and William Robert Griffith, New York). September 3, 1873.—No. 2904. The invention consists in the process of amalgamating and reducing sulphuretted ores, containing gold or silver, or other metals, *in vacuo*; and also in the method or process of reclaiming and condensing the vapourised mercury and sulphur, *in vacuo*, in their separate elementary parts again.

Improvements in apparatus for the manufacture of sulphate of soda and sulphate of potash. William Hunt, manufacturing chemist, Castleford, near Normanton, York. September 8, 1873.—No. 2944. In making sulphate of soda and sulphate of potash by introducing into chambers, containing chloride of sodium and chloride of potassium respectively, a mixture of sulphurous acid gas, atmospheric air, and steam, the chambers employed and other parts of the apparatus are made of cast-iron. This invention consists in making the said chambers of brick, clay or other cement being used in place of mortar, the space between the exterior of the brick chambers and the wall enclosing them being filled with powdered chloride of sodium or common salt rammed or pressed therein. By the consolidation of the said chloride of sodium, an air-tight packing is formed between the chambers and the outer wall, which packing is unacted upon by the hydrochloric acid gas evolved. The powdered chloride of sodium may be mixed with clay or sand, or sulphate of soda or baryta, or burnt clay may be employed in place of chloride of sodium.

An improved process for treating copper pyrites, copper blendes, and other sulphuretted copper ores which contain iron. Joseph Anthony Dixon, writer, Glasgow, N.B. (A communication from Thomas Henry Copley, chemist, Turin, Italy). September 11, 1873.—No. 2981. The features of novelty constituting this invention are—First, the process for treating copper pyrites, copper blendes, and other sulphuretted copper ores containing iron; secondly, the employment of calcium hydrate or lime in reducing copper ores poor in sulphur.

Improved combinations of ingredients for producing explosives for blasting and mining purposes. William Blanch Brain, mining engineer, St. Annals, Cinderford, Gloucester. September 11, 1873.—No. 2984. This consists in combining in certain proportions nitroglycerin, chlorate of potash, sugar, charcoal, ground coal, sawdust, dextrin, starch, and sumach, so as to form highly concentrated explosive bodies.

NOTES AND QUERIES.

Metallic Solutions.—Would any of your readers be kind enough to inform me if there is a market for a "strong solution of zinc and iron," a solution of "tin and iron," and precipitated oxide of zinc?—ARTHUR T. BECKS.

Egg Albumen.—Can you tell me of anyone who makes egg albumen in England? I am told that there is no maker of it in this country, which seems unlikely. If there are none in England, where is it made?—WILLIAM E. A. AXON.

Ash of Plants.—Can you tell me of any work in which I shall find analyses of the ashes, and percentage of ash, of the different plants, &c. (clover, wheat, turnips, mangel wurzel, &c.), principally cultivated in this country?—H. B. YARDLEY.

Filtration on the Large Scale.—Will some of your readers kindly tell me how to filter, on a large scale, a black lake (logwood and iron), which will not settle so as to be washed by decantation, and is not drainable by the methods usually employed for filtering?—E. B. M.

Lime Crucibles.—Can you kindly inform me where crucibles of lime can be procured, such as those described in chemical works as used in fusing Pt before the oxyhydrogen blowpipe, but I require them on a much smaller scale than they are probably used commercially?—DELTA.

Flies.—Will you please to tell in your next number if you know of anything that will keep flies off hams when they are hanging in grocer's shops, as the maggots cause a great loss to the trade every year; it must be something that will not make the hams taste, or they will be spoiled?—JOHN MURRAY.

MEETINGS FOR THE WEEK.

MONDAY, June 15.—Royal Geographical, 8.30.

— Zoological, 8.30.

TUESDAY, 16.—Anthropological Inst., 8.

WEDNESDAY, 17.—Meteorological, 7.

THURSDAY, 18.—Royal, 8.30.

— Chemical, 8.

— Philosophical Club, 6.

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THE CHEMICAL NEWS.

VOL. XXIX. No. 760.

THE SUCCESSOR OF STEAM.

By Dr. H. BEINS.

FOR many years I have, with the collaboration of my brother, J. F. Beins, Director of the Netherlands Soda Manufactory at Amsterdam, considered the question—How to transform heat into mechanical power more advantageously than it is done in our common steam and other engines. It occurred to us to make an experiment to see what degree the tension of the carbonic acid given off by natrium-bicarbonate would amount to, when heated in a closed space. We were surprised and much satisfied to find, that when natrium-bicarbonate (or the corresponding salt of kalium) in a dry pulverised state or in a watery solution is heated in a closed space, a part of the carbonic acid is given off and condensed in a not heated portion of that space, so that at a temperature of 300° to 400° C. liquid carbonic acid can be distilled out of those salts with a tension of from 50 to 60 atmospheres. I have had the satisfaction to show this experiment to several scientific men in this country (Holland), who have taken the greatest interest in the matter.

The said fact is of the greatest importance, for the following reasons:—(1). Carbonic acid of high tension (in particular liquid carbonic acid, which I have called, for the sake of convenience, carboleum) is a very remarkable body physically. By the simple method above mentioned, it can be obtained easily and in any quantity. I call attention here to the anomaly with respect to Boyle's law and the remarkable properties of liquid and solid carbonic acid, which until now have been so incompletely studied.

(2). The chemical relations of bodies under high pressures begin nowadays to be studied. For these inquiries a simple compressing apparatus is of great importance. Of course, for lower tensions than 50 to 60 atmospheres the temperature need not be raised to 300° to 400° C., but a lower degree suffices. With a saturated solution of natrium-bicarbonate heated in a boiling bath of concentrated solution of common salt, I obtained carbonic acid of 3 to 5 atmospheres. Other experiments showed that the tension increases regularly with the temperature.

(3). Compressed carbonic acid is much required for manufacturing mineral waters and other beverages.

(4). The compressed state of this gas is a condition of great importance for its application in technical chemistry.

(5). Carbonic acid of high tension, in particular carboleum, is an excellent motive power for small and great industries. This is already remarked by the discoverer of liquid carbonic acid, Faraday, subsequently by Thilorier and others, who were, unfortunately, not acquainted with the knowledge of the law of conservation of energy, which is indispensable to judge these sort of questions.

In this last case, the cost of the carbonic acid appears to be of greater importance than in the four before-mentioned modes of application. But this is principally not the case. A method, however, discovered by us for obtaining carbonic acid very cheaply is at present applied in manufacturing natrium-bicarbonate in a factory, established by us, where the salt can be obtained for manufacturers, and from which a cheap carbonic acid can be procured.

One litre of carboleum of 15° C. and a tension of 50 atmospheres weighs approximatively 0.8 kilogram., and can produce 400 litres of carbonic acid gas of the ordinary atmospherical tension. Suppose, now, these 400 litres

compressed to 50 atmospheres. The work required for that compression is represented in every case (however much may be the anomaly with regard to Boyle's law) by a mathematical figure of the same area as the hyperbolic plane, that represents the power for compressing an equal volume of air to 50 atmospheres, and this amounts to about 17,000 kilogrammetres. Per horse-power and per hour (270,000 kilogrammetres) is thus required about 16 litres carboleum of 50 atmospheres and 15° C.

Here and in the following I take, for greater simplicity, even numbers.

Only when a carboleum engine works with great intermissions can the heat of vaporation required be taken from the sides of the reservoir without artificial heating. In the majority of cases, however, the carboleum must be evaporated by the artificial heating of small quantities at a time. The heat required per horse-power hourly (270,000 kilogrammetres) amounts at least to 640 calories (0.1 kilogr. of coal). But now the objection may be made, the quantity of carboleum required for an engine of greater dimensions and continuously working is too considerable, and therefore the reservoirs must be made too heavy. And for this reason carboleum would not be applicable otherwise than for small engines working with intermissions. The fact is that greater carboleum engines must work with regeneration. They must have a store of natrium-bicarbonate and of carboleum, so that the decomposed bicarbonate is regenerated again by the carbonic acid that has worked in the engine. Such an engine transforms very advantageously the heat (furnished by the fire for decomposing the continually regenerated bicarbonate) in mechanical work. Supposing the gas working with a temperature of 100° C., the 16 litres of carboleum required hourly per horse-power are reduced to 10 litres. Such an engine requires about 0.3 kgrm. of coal per horse-power hourly, whilst the best steam-engine requires 1.2 to 0.9 kgr.

As regards the use of carboleum-engines for ships, the weight of such an engine, for instance, of 100 horse-power and combustible stores for 240 hours, may be calculated to be one-fifth less than the weight of a steam-engine of the same power. And, as many parts of the carboleum engine must be more massive, it will require less space.

Since the working of a carboleum-engine without regeneration depends on a neighbouring carboleum-manufactory, generally the engines with regeneration are to be preferred for small factories as well as for great ones. Cheap carbonic acid is therefore no essential condition for the applicability of my method for the production of motive power.

Carboleum is without danger, since it does not contain any cause of explosion, and moreover, it is for various reasons preferable to use reservoirs consisting of smaller compartments. A too abundant accumulation of the gas in the engine-rooms, so that it renders the air irrespirable, can easily be prevented. When water is not present, the metallic parts of the engine remain unaltered by the carbonic acid.

I have experimentally found that a carboleum-engine is easily constructed. Taps and joints can be made to answer perfectly. A year ago I filled a tube of hammered copper with carbonic acid of 50 atm., and not the least loss is as yet observed. Wrought metals are therefore not permeable for gases of that tension. Perhaps the phenomena of porosity, belonging to the common air-pump experiments, are partly caused by surface-condensation.

When, according to the law of Dulong and Petit, 0.25 is taken as the specific heat of natrium bicarbonate, and, moreover, the common physical laws are considered, everybody taking the great law of energy as their mentor, will easily grant the following assertions as founded on scientific facts.

For the great industry, the carboleum-engine can in

almost every case substitute the steam-engine. For the small industry, specially for engines working with intermissions and during brief spaces of time, the property of carbolem of being always ready for work is of much importance; for instance, for printing-presses, fire-engines, street-locomotives, &c.

By this same property, and since the mechanical equivalent of electricity is very small, a carbolem-engine is a very fit and cheap source of electrical light. Such a light would come at a much less cost than the ordinary gas-light; and, considering this great advantage, the objection that we do not yet possess good electrical lamps for common use loses much of its value.

My method of compression furnishes easily the required tension for the conveyance of letters in tubes, and the modern break apparatus for railways.

Perhaps the property of carbolem of possessing a power of projection a hundred times cheaper than gunpowder can be made use of.

The fact that a carbolem-engine with a sufficient store of carbolem is independent of our atmosphere, makes it possible to construct a vessel, provided with means to sink to any depth of the sea, to rise and sink at will, to cruise about under water, and to maintain the life of the crew during that operation, to develop light, &c. The importance of this for scientific discoveries and industrial purposes is evident. For the purposes of war, also, must such a small and comparatively cheap submarine vessel place a peculiar, nay a decisive, weight in the scale in the question of our modern ironclads. Our late (Dutch) Minister of the Navy has taken great interest in a project for submarine vessels elaborated and proposed by me, and ordered an inquiry into it. The Commission appointed, after having examined the project, agreed with me regarding the main points. For reasons independent of the project itself, the Government has as yet not resolved upon the immediate execution of the project.

Freezing machines working by evaporation of carbolem produce ice at a much less cost than any existing freezing apparatus.

Regarding this general usefulness of carbonic acid, it is important to call attention to the fact that an inexhaustible store of carbolem is at our disposition in common chalk, for this mineral contains carbonic acid to the amount of half its weight; it can therefore produce twice its volume of carbolem.

With these brief remarks I give up my discovery to publicity. The great trouble and expense which the inquiry has taken for many years, make it our duty to try to profit by its industrial importance. Therefore I have patented the invention in several countries. But, since the extensiveness of the application widely surpasses my knowledge and my power, I invite anybody who takes an interest in the matter to aid me in applying to practical purposes my method of compression of carbonic acid. I will readily communicate my experience of the several special applications.

Groningen (The Netherlands),
May 1, 1874.

NOTE ON THE ACTION OF LIGHT UPON NITRIC ACID.

By W. H. ASTON PEAKE.

PURE nitric acid, when exposed to light, for any length of time, gradually turns of a yellowish green tint, and the unoccupied portion of the bottle containing it becomes filled with brown fumes.

On sealing a quantity of the acid in a flask, and exposing it to direct sunlight for three days, the action became very strongly marked, and on examination the acid was found to contain a considerable quantity of nitrous acid. I would presume, therefore, that the action is a reducing one.

NOTE ON THE ABSORPTION-SPECTRA OF POTASSIUM AND SODIUM AT LOW TEMPERATURES.*

By H. E. ROSCOE, F.R.S., and ARTHUR SCHUSTER.

IN order to obtain the absorption-spectrum afforded by the well known green-coloured potassium vapour, pieces of the clean dry metal were sealed up in glass tubes filled with hydrogen, and one of these was then placed in front of the slit of a large Steinheil's spectrocope furnished with two prisms having refracting angles of 45° and 60° . The magnifying power of the telescope was 40, and was sufficient clearly to separate the D lines with one prism. A continuous spectrum from a lime-light was used, and that portion of a tube containing the bright metallic globule of potassium was gently heated until the green vapour made its appearance. A complicated absorption-spectrum was then seen, a set of bands (α) in the red coming out first, whilst after a few moments two other groups appeared on either side of the D lines, the group β (less refrangible) being not so dark as the group γ . These bands are all shaded off towards the red, and in general appearance resemble those of the iodine spectrum. In order to assure ourselves that the bands are not caused by the presence of a trace of an oxide, tubes were prepared in which the metal was melted in hydrogen several times on successive days until no further change in the bright character of the globule could be perceived. On vapourising the metal, which had been melted down to a clean portion of the tube, the bands were seen as before, and came out even more clearly, the globule, after heating, exhibiting a bright metallic surface. An analysis of the potassium used showed that it did not contain more than 0.8 per cent of sodium, although, of course, the double line D was always plainly seen.

In order to ascertain whether an alteration in the absorption-spectrum of the metal takes place at a red heat, fragments of potassium were placed in a red-hot iron tube, through which a rapid current of pure hydrogen gas was passed, the ends of the tube being closed by glass plates. The magnificent green colour of the vapour was clearly seen at this temperature on looking through the tube at a lime-light placed at the other end. Owing, doubtless, to the greater thickness or increased pressure of the vapour, the bands seen by the previous method could not be resolved by the small spectrocope employed, the whole of the red being absorbed, whilst a broad absorption-band in the greenish yellow was seen occupying the place of the group γ .

The positions of the bands obtained by the first method were measured by means of a telescope and distant scale, and the wave-lengths obtained by an interpolation curve, for which well-known air-lines were taken as references. The following numbers give the wave-lengths of the most distinct, that is, the most refrangible edge of each band. As the measurements had to be quickly made, owing to the rapid darkening of the glass by the action of the metallic vapour, these numbers do not lay claim to very great accuracy, but fairly represent the relative positions of the band, and show that they do not always occur at regular intervals, although they are pretty regularly spread over the field, and all are shaded alike.

Bands of potassium shaded off towards red. Wave-length in tenth-metre:—

6844	6459	6311	5949	5763
6762	6430	6300	5930	5745
6710	6400	6275	5901	5732
6666	6379	6059	5860	5712
6615	6357	6033	5842	5700
6572	6350	6012	5821	5690
6534	6331	5988	5802	5674
6494	6322	5964	5781	5667

* Abstract of a Paper read before the Royal Society.

The bright potassium lines in the red and violet were not seen reversed, the intensity of the lime-light being too small at both extremes to render an observation possible.

In order to ascertain whether the vapour of sodium, which, when seen in thin layers, appears nearly colourless, exhibits similar absorption-bands, tubes containing the pure metal, which had been prepared and preserved out of contact with any hydrocarbon, were prepared, the metal being obtained free from oxide and the absorption-spectrum being observed in the manner already described. As soon as the metal began to boil, a series of bands in the blue ($\text{Na}\gamma$) made their appearance, and shortly afterwards bands in the red and yellow ($\text{Na}\alpha$), stretching as far as the D lines, came out. At this period of the experiment the D lines widened, thus blotting out a series of fine bands occurring in the orange ($\text{Na}\beta$), some of which could in consequence not be mapped. All the bands of the sodium-spectrum shade off like the potassium bands towards the red.

When the vapour of sodium is examined in a red-hot iron tube, the colour of the lime-light as seen through it is a dark blue. As the sodium is swept away by the current of hydrogen passing through, the colour becomes lighter, and the transmitted rays can be analysed by the spectroscope. At first, the whole red and green and part of the blue is cut out entirely. The D lines are considerably widened, and an absorption-band is seen in the green, apparently coinciding with the double sodium line, which comes next in strength to the D lines. All the colours, therefore, seem to be shut out except part of the orange, part of the green, and the ultra blue. As the sodium vapour becomes less dense, more light passes through, and the same absorption-bands are seen as are observed in the other method. The vapour then has a slight bluish-green tint, but is nearly colourless.

The following numbers give the wave-lengths of the more refrangible edge of the sodium absorption-bands in tenth-metres obtained in the manner above described:—

6668	6361	6105	5999	β	4964
6616	6272	6092	5150		4927
6552	6235	6071	5129		4889
6499	6192	6051	5082	γ	4863
6450	6162	6035	5038		4832
6405	6149	6016	5002		4810

ON THE
ALLEGED EXPANSION IN VOLUME OF
VARIOUS SUBSTANCES
IN PASSING BY REFRIGERATION
FROM THE
STATE OF LIQUID FUSION TO THAT OF
SOLIDIFICATION.*

By ROBERT MALLET, F.R.S., &c.

SINCE the time of Reaumur it has been stated, with very various degrees of evidence, that certain metals expand in volume at or near their points of consolidation from fusion. Bismuth, cast-iron, antimony, silver, copper, and gold are amongst the number, and to these has recently been added certain iron furnace-slugs. Considerable physical interest attaches to this subject from the analogy of the alleged facts to the well-known one that water expands between 30° and 32° F., at which it becomes ice; and a more extended interest has been given to it quite recently by Messrs. Nasmyth and Carpenter having made the supposed facts, more especially those relative to cast-iron and to slags, the foundation of their peculiar theory of lunar volcanic action, as developed in their work "The Moon as a Planet, as a World, and a Satellite" (4to, London, 1874). There is considerable ground for believing that bismuth does expand in volume at or near consolidation;

* Abstract of a Paper read before the Royal Society.

but, with respect to all the other substances supposed to do likewise, it is the object of this paper to show that the evidence is insufficient, and that, with respect to cast-iron and to the basic silicates constituting iron slags, the allegation of their expansion in volume, and therefore their greater density when molten is greater than when solid, is wholly erroneous. The determination of the specific gravity in the liquid state of a body having so high a fusing temperature as cast-iron is attended with many difficulties. By an indirect method, however, and operating upon a sufficiently large scale, the author has been enabled to make the determination with considerable accuracy. A conical vessel of wrought-iron, of about 2 feet in depth and 1.5 feet diameter of base, and with an open neck of 6 inches in diameter, being formed, was weighed accurately empty, and also when filled with water level to the brim; the weight of its contents in water, reduced to the specific gravity of distilled water at 60° F., was thus obtained. The vessel, being dried, was now filled to the brim with molten grey cast-iron, additions of molten metal being made to maintain the vessel full until it had attained its maximum temperature (yellow heat in daylight) and maximum capacity. The vessel and its contents of cast-iron when cold were weighed again, and thus the weight of the cast-iron obtained. The capacity of the vessel when at a maximum was calculated by applying to its dimensions at 60° the coefficient of linear dilatation, as given by Laplace and others, to its range of increased temperature; and the weight of distilled water held by the vessel thus expanded was calculated from the weight of its contents when the vessel and water were at 60° F., after applying some small corrections.

We have now the elements necessary for determining the specific gravity of the cast-iron which filled the vessel when in the molten state, having the absolute weights of equal volumes of distilled water at 60° , and of molten iron. The mean specific gravity of the cast-iron which filled the vessel was then determined by the usual methods. The final result is that, whereas the specific gravity of the cast-iron when cold was 7.170, it was only 6.650 when in the molten condition; cast-iron, therefore, is less dense in the molten than in the solid state. Nor does it expand in volume at the instant of consolidation, as was exclusively proved by another experiment. Two similar 10-inch spherical shells, 1.5 inches in thickness, were heated to nearly the same high temperature in an oven, one being permitted to cool empty as a measure of any permanent dilatation which both might sustain by mere heating and cooling again, a fact well known to occur.

The other shell, when at a bright red heat, was filled with molten cast-iron, and permitted to cool, its dimensions being taken by accurate instruments at intervals of thirty minutes, until it had returned to the temperature of the atmosphere (53° F.), when, after applying various corrections, rendered necessary by the somewhat complicated conditions of a spherical mass of cast-iron losing heat from its exterior, it was found that the dimensions of the shell whose interior surface was in perfect contact with that of the solid ball which filled it were, within the limit of experimental error, those of the empty shell when that also was cold (53° F.), the proof being conclusive that no expansion in volume of the contents of the shell had taken place.

It is a fact, notwithstanding what precedes, and well known to iron-founders, that certain pieces of cold cast-iron do float on molten cast-iron of the same quality, though they cannot do so through their buoyancy, as various sorts of cast-iron vary in specific gravity, at 60° F., from nearly 7.700 down to 6.300, and vary also in dilatibility; that thus some cast-irons may float or sink in molten cast-iron of different qualities from themselves through buoyancy or negative buoyancy alone. But, where the cold cast-iron floats upon molten cast-iron of less specific gravity than itself, the author shows that some other force, the nature of which yet remains to be investigated, keeps it floating; this the author has pro-

visionally called the repellent force, and has shown that its amount is, *cæteris paribus*, dependent upon the relation that subsists between the volume and "effective" surface of the floating piece. By "effective" surface is meant all such part of the immersed solid as is in a horizontal plane, or can be reduced to one. The repellent force has also relations to the difference in temperature between the solid and the molten metal on which it floats.

The author then extends his experiments to lead, a metal known to contract greatly in solidifying, and with respect to which no suggestion that it expands at the moment of consolidation. He finds that pieces of lead having a specific gravity of 11.361, and being at 70° F., float or sink upon molten lead of the same quality, whose calculated specific gravity was 11.07, according to the relation that subsisted between the volume and the "effective" surface of the solid piece—thin pieces with large surface always floating, and *vice versa*. An explanation is offered of the true cause of the ascending and descending currents observed in very large "ladles" of liquid cast-iron, as stated by Messrs. Nasmyth and Carpenter. The facts are shown to be in accordance with those above mentioned, and, when rightly interpreted, to be at variance with the views of these authors.

Lastly, the author proceeds to examine the statements made by these authors as to the floating of lumps of solidified iron-furnace slag upon the same when in a molten state; he examines the conditions of the alleged facts, and refers to his own experiments upon the total contraction of such slags, made at Barrow Ironworks, and a full account of which he has given in his paper on "The True Nature and Origin of Volcanic Heat and Energy," printed in *Phil. Trans.*, 1873, as conclusively proving that such slags are not denser in the molten than in the solid state, and that the floating referred to is due to other causes. The author returns thanks to several persons for facilities liberally afforded him in making these experiments.

ON THE PHYSIOLOGICAL ACTION OF LIGHT.*

By JAMES DEWAR,

Lecturer on Chemistry, University of Edinburgh,

and JOHN G. M'KENDRICK, M.D.,

Demonstrator of Practical Physiology, University of Edinburgh.

(Continued from page 258).

II.

SINCE the date of the first communication, we have endeavoured to obtain quantitative results, involving time as a variable element in the case of the action of light on the retina and optic nerve. We have, therefore, found it necessary to construct a true graphical representation of the variations of the electro-motive force occasioned by the impact and cessation of light. It is clear that to register minute galvanometrical alterations, the only plan that could be employed would be to photograph on a sensitive surface, covering a cylinder rapidly revolving on a horizontal axis, the alteration of position of the spot of light reflected from the mirror, just as continuous magnetic observations are registered. As the apparatus required to execute these observations is very complicated, and would require much preliminary practice, we have in the meantime adopted a simpler method of registration. This plan is to note the position of the galvanometer at equal intervals of time, before, during, and after the impact of light on the eye. In these observations we have used a seconds pendulum giving a loud beat. One observer reads aloud the galvanometer; the other marks every interval of two and a-half seconds, registers the numbers obtained, and regulates the supply of light. A little practice in the method above described has enabled us to obtain very satisfactory results, agreeing very closely in different observations, and showing in a decided way the salient points of the variation curve.

* Read before the Royal Society of Edinburgh.

These curves show that on the impact of light there is a sudden increase of the electro-motive force; during the continuance of light it falls to a minimum value, and on the withdrawal of light, there is what we term an *inductive effect*, that is to say, a sudden increase of the electro-motive force which enables the nerve to acquire its normal energy. The falling off of the electro-motive force by the continued action of light, is the physical representative of what, in physiological language, is called fatigue; the inductive effect exhibiting the return of the structure to its normal state. Occasionally the impact of light is not followed by a rise in the electro-motive force, but by a diminution. This is probably to be explained by the fact, that the death of the retina and nerve is indicated by a gradual falling of the electro-motive force, and that this change frequently goes on so rapidly that the impact of light is unable to produce any rise. In these circumstances, the spot of light, which before the impact of light was slowly moving downwards, is on the impact steadied for a moment, and then pursues its downward course more rapidly.

We have carried out since last communication, several distinct sets of observations:—

1. We have proved that though there is no difficulty in obtaining a strong current from the skin of the frog, this current is not affected by light. This observation demonstrates that the pigment cells of the skin in the vicinity of the cornea have nothing to do with the results obtained.

2. The current obtained from a mass of the pigment cells of the choroid, does not exhibit any sensitiveness of light.

3. The subcutaneous injection into the frog of woorara, santonin, belladonna, and calabar bean, does not destroy the sensibility of the retina to light.

4. As to the action of the anterior portion of the eye. On carefully bisecting an eye of a frog, so as to remove completely the anterior portion, including cornea, aqueous humour, iris, ciliary-muscle, and lens, and on bringing the retina into actual contact with one of the clay pads, we readily obtained a large deflection, which was as sensitive to light as when the whole eye was employed, thus eliminating any possibility of the contraction of the iris under the stimulus of light having to do with the results previously obtained.

5. On using the anterior portion of the eye, so that the cornea and posterior surface of the crystalline lens were the poles, we obtained a large deflection, which was, however, insensible to light.

6. The sclerotic and nerve without the retina, in the same manner, gave a large natural electro-motive force, also not sensitive.

7. The distribution of the electro-motive force between the different portions of the eye and cross section of the nerve may be stated as follows: The most positive structure is the cornea, then the sclerotic, then the longitudinal surface of the nerve; the cornea is also positive to the posterior surface of the crystalline lens, and the retina itself seems to be positive to the transverse section of the nerve.

8. As to the effects produced by lights of different intensities. If a candle is placed at a distance of one foot from the eye, and then is removed ten feet, the amount of light received by the eye is exactly one-hundredth part of what is got at a distance of one foot, whereas the electro-motive force, instead of being altered in the same proportion, is only reduced to one-third. Repeated experiments made with the eye in different positions has conclusively shown that a quantity of light one hundred times in excess of another quantity, only modifies the electro-motive force to the extent of increasing it three times as much, certainly not more.

9. It was apparent to us that these experiments would ultimately bear upon the theory of sense-perception as connected with vision. It is now generally admitted that no image, as such, of an external object, is conveyed to the sensorium, but that in reality the brain receives certain impressions of alterations taking place in the receiving organ. The natural query then arises,—are the physical

effects we have described and measured really comparable in any way with our sensational differences in light perception, when we eliminate all mental processes of association, &c., and leave only preception of difference of intensity? In other words, are these changes the representative of what is conveyed to the sensorium? It would appear, at first sight, that this problem is altogether beyond experimental inquiry. There is, however, a way of arriving at very accurate measures of the variation of our sensational differences in the case of light, and this has been developed theoretically and experimentally by the justly renowned physiologist Fechner. Stating the law of Fechner* generally, we may say, the difference of our sensations is proportional to the logarithm of the quotient of the respective luminous intensities. A recent series of experiments by Dalbœuf† has entirely confirmed the truth of this law. If, therefore, the observed differences in electro-motive power, registered under conditions of varying luminous intensity, agree with this law of Fechner, regulating our sensational impressions, then there can be little doubt these variations are the cause of, and are comparable to, our perception of sensational differences. Now, we have stated above, that with a quantity of light 100 times in excess of another quantity, the electro-motive force only becomes three times greater. According to Fechner's law, we may say the difference of our sensations, with that variation in the amount of luminous intensity, would be represented by 2, the logarithm of 100. Our experimental results being as 3 to 1, the difference is also 2, thus agreeing very closely. It is to be remembered, however, that these results have been obtained by experiment on the eye of the frog, but similar changes have been observed in the eyes of mammals. In the latter, however, the amount of alteration is not so great, in all probability owing to the rapid death of the parts.

10. When one clay point is placed in contact with the cornea or nerve, and the other with the section of the optic lobe, a current is at once obtained which is sensitive to light. In this experiment the eye is left in the orbit, and the nerve is uninjured. Thus, the effect of light on the retina has been traced into the brain.

(To be continued.)

ON THE INTERVENTION OF ATMOSPHERIC NITROGEN IN VEGETATION.

By P. P. DEHERAIN.

IF we determine the quantity of nitrogen contained in the manure placed upon a plot of arable land, and then find the amount of the same element present in the crop developed under its influence, we find that the manure cannot account for the nitrogen of the crop, the latter being greater. This fact has been established by Bous-singault as regards the cultivated soils of Alsace, and confirmed by Hervé Mangon in case of the irrigated lands of Provence. Nevertheless, the soil thus treated does not become exhausted of nitrogenous matters. We find, in fields dunged with this manure, which would seem insufficient, a notable quantity of combined nitrogen, which goes on increasing as long as the system of cultivation is prolonged. How does the atmospheric nitrogen act? What is the mechanism of its fixation?

The author's first experiments aimed at finding reactions which might cause this fixation. He supposed that this change was produced in the soil along with the slow combustion of vegetable detritus of all kinds, by a phenomenon analogous to what ensues when a mixture of atmospheric air and of hydrogen is detonated, and a trace of nitric acid appears along with the water produced. He therefore sought to detect a diminution in the volume of nitrogen

introduced into tubes along with organic matter, sealed up and heated.

The results obtained by the aid of mixtures of glucose and ammonia, glucose and potassa, and ulmic matters, were not constant, but the successes were too frequent, and the amount of gaseous nitrogen which disappeared too great, to be the result of any mistake or accident. The original procedure was gradually improved, so as to render the chances of error fewer and less important, and a successful experiment in the month of July last showed that the results announced were exact, but that the interpretation first put upon them required to be abandoned.

The following was the procedure employed in the first series of experiments:—An ordinary combustion-tube of the capacity of 60 to 80 c.c. was closed at one end, and a small glass bulb was introduced containing the substance to be analysed. The tube was then drawn out at the open end, allowed to cool, and then rapidly sealed up. At that moment it contained a quantity of gas equal to the interior capacity of the combustion-tube, *minus* the exterior volume of the bulb. In July last, at the termination of an experiment of this kind, in which 47.5 c.c. of air had been allowed to react upon a mixture of glucose and ammonia, 21 c.c. of nitrogen only were found. Out of the original 38 c.c. of nitrogen, 17 c.c. had, therefore, disappeared. In another experiment, perfectly analogous, 33.6 c.c. of nitrogen contained in the tube at the outset were reduced to 20 c.c., 13.6 c.c. having disappeared. In the former case, 42.5 c.c. of oxygen would be requisite to form nitric acid with the 17 c.c. of nitrogen absorbed. In the second, 34 would be required. The quantities present in the two cases were, respectively, 9.5 c.c. and 8.4 c.c. only. Furthermore, in a great number of experiments the author found that carbonic acid was generated. Hence, it is easy to see that not nitric acid, but another azotised compound, must be generated in the tube. On heating the tube to a higher temperature than that employed at first, the results were no better. The presence of cyanogen compounds was never detected in the results of the experiments, whence the conclusion was drawn that the nitrogenous body formed must be ammonia. On decomposing glucose or ulmic acid in presence of an alkali, hydrogen had, therefore, probably been liberated, and this nascent hydrogen, combining with the nitrogen, formed ammonia, which finally united with the carbonaceous matters to form one of the nitrogenous compounds discovered by P. Thenard.

The idea that ammonia might be formed in the soil the reaction of hydrogen upon atmospheric nitrogen is not novel. It has been, in particular, put forward by Mulder in his "*Chimie Appliquée à la Physiologie*;" but not having been supported by sufficient proofs, it did not meet with acceptance, and was absolutely rejected by Messrs. Lawes, Gilbert, and Pugh in their great memoir inserted in the *Philosophical Transactions* for 1861.

The foregoing experiments showed that this formation of ammonia took place in reactions more rapid, but at the same time more energetic than those produced in the soil. The author sought next to ascertain whether ammonia could be produced at ordinary temperatures, and under the influence of such matters as the soil might be expected to contain. It is plain, from the experiments above described, that the disappearance of gaseous nitrogen must be but slight, since even when alkalies were used and higher temperatures applied, only a few cubic centimetres were ordinarily found to disappear. A more rigorously exact procedure was, therefore, needful. The following method was therefore adopted:—A known volume of air was measured over mercury, the pressure and the temperature being noted. Into this air the substances destined to act upon the nitrogen were next introduced, such as humus from old wood, sawdust, decomposed wood, glucose mixed with lime, potash, soda, ammonia, &c. The whole was then exposed to ordinary temperatures, or to a heat not exceeding 35°. After the lapse of eight to fifteen days, the carbonic acid in the mixture was

* Fechner, *Elemente des Psychophysik*. Helmholtz, *Optique physiologique*.

† Recent Memoir to Belgian Academy.

absorbed by means of potassa, the oxygen by pyrogallie acid, and the residual nitrogen was transferred to a narrow tube, where the tenths of a cubic centimetre could easily be read off. The original volume of nitrogen reduced to the temperature of 0° and the pressure of 760 m.m., was then compared with the residual volume, and the increase or decrease noted.

This mode of operation presents an irregularity. It always happens, when a solid body is introduced into the receiver containing the measured gases, that a small amount of air is introduced at the same time. This is disengaged under the influence of the diminished pressure to which it is subject during the course of the experiment. It will, however, be perceived that this error tends to augment the proportion of nitrogen contained in the receiver and to mask its fixation, and not, on the contrary, to simulate an absorption which does not really take place. The author has given, in the *Annales des Sciences Naturelles*, a long series of observations made by this method. Many of the results are negative; others, on the contrary, prove distinctly that, during the slow combustion of ulmic matters or of hydrates of carbon, gaseous nitrogen disappears. Wood and humus gave especially distinct results, the amount of nitrogen absorbed ranging from 2 to 10 c.c.

In one of these experiments, a result was obtained which led to a third mode of operating, preferable to the foregoing. In the gas receiver there remained not a trace of oxygen, and 21.8 c.c. of carbonic acid had been formed for 100 c.c. of air originally present, whilst 2.8 c.c. of nitrogen had disappeared. From this result, the inference was drawn that it was not the combustion produced by the atmospheric oxygen which favours the disengagement of hydrogen and the formation of ammonia, but that a more complete combustion must be obtained, during which carbonic acid is formed at the expense of the elements of the body itself, in consequence of what Berthelot happily calls "internal combustion."

The most successful experiments were those in which the atmospheric oxygen had completely disappeared. Hence the idea was suggested that such oxygen was possibly not merely useless, but even opposed to the production of the phenomenon which was being studied. If, in fact, the hydrogen at the moment of its liberation from an organic compound, is able to combine with nitrogen, we cannot doubt that it must be equally, and even more, able to unite with oxygen, so as to form water.

To submit this hypothesis to experimental verification, the observations made at common temperatures were provisionally laid aside, and an attempt was made to produce directly a nitrogenous compound by passing a current of pure nitrogen into a mixture of glucose and an alkali, both free from nitrogen, and gently heated to facilitate the reaction. The operation was completely successful.

On evaporating the black matter thus obtained, and determining its nitrogen, this element was always found in notable proportions. Thus 10 grms. of glucose employed yielded 0.071 gm. of fixed nitrogen, or 7.1 grms. per kilo. In another experiment, made with glucose, soda, and pure nitrogen, the result was 6.5 grms. of combined nitrogen per kilo. If atmospheric air was used instead of pure nitrogen, the amount fixed fell as low as 1.5 grms.

The experiments at ordinary temperatures were then resumed, pure nitrogen being placed over mercury instead of atmospheric air. The purity of the gas employed was always ascertained previously, and the temperature was the same as that of the air of the laboratory. Almost all the experiments were successful; out of twenty-one, two only gave negative results. The nineteen others showed absorptions ranging from 0.5 c.c. to 5.9 c.c. with a mixture of glucose and soda; sawdust and lime absorbed from 1 to 1.7 c.c. of nitrogen. The results of all these experiments may be thus stated:—

(1). Atmospheric nitrogen is capable, at such tempera-

tures as may naturally occur in the soil, of becoming fixed in carbonaceous principles analogous to those naturally produced in the soil by the decomposition of vegetable matter.

(2). The presence of oxygen impedes the manifestation of this phenomenon, which is much more distinct with pure nitrogen than with common air.

These facts appear to have an important bearing upon agricultural practice. P. Thenard has long ago clearly recognised that there exist in the soil two distinct atmospheres, the one reducing and the other oxidising. It is in the reducing atmosphere that the fixation of nitrogen is accomplished, favoured by the mass of carbonaceous matter accumulated during cultivation. The part played by the carbonaceous matter contained in farm-yard manure and in green crops, often ploughed in with so much advantage, appears to me to be twofold. These matters, whilst decomposing, not merely yield the hydrogen needful for the fixation of the nitrogen, but, by taking possession of the oxygen confined in the soil, they favour the formation of an atmosphere poor in oxygen, in which the fixation of nitrogen and the formation of the black matters studied by P. Thenard take place.

NOTICES OF BOOKS.

Water Analysis: a Practical Treatise on the Examination of Potable Water. By J. ALFRED WANKLYN and ERNEST THEOPHRON CHAPMAN. Third Edition, entirely re-written by J. A. WANKLYN. London: Trübner and Co.

THE appearance of a third edition of this manual is a proof at once of the sustained interest felt in sanitary science, and of the confidence felt in the ammonia process, which has rendered the analysis of water as to its effects on public health practicable and trustworthy. The work has been re-arranged and considerably enlarged. The chapter describing the determination of free and "albumenoid" ammonia has been greatly improved. The requisite apparatus, the preparation of the reagents, and the performance of every step of the process are concisely but clearly described. As an important addition, we note the instructions for effecting an analysis upon so small a quantity as 100 c.c. of water, the Nesslerising being brought to within one thousandth of a milligram. In these cases the colouration is to be examined in the meniscus of the liquid.

Attention is particularly drawn to the presence of poisonous metals in water—a point too little regarded by the generality of analysts, though far from unlikely both in manufacturing districts and in the waters obtained from mountain ranges. We have felt bound to enter our protest against the absence of any special prohibition of chromium in the "recommendations" of the Rivers' Pollution Commissioners. We are happy to find that Mr. Wanklyn shares our views on the possibility of chromium compounds finding their way into drinking waters, and that he gives instructions for their detection. We quite agree with him that before any water is selected for the supply of a town its freedom from lead, copper, chrome, barium, arsenic, &c., should be most carefully ascertained. We have no evidence that traces of these metals can be eliminated by filtration.

The following passage is very interesting in view of the contradictory statements made by eminent chemists on the distribution of iodine:—"The existence of traces of iodates in natural waters deserves to be referred to, inasmuch as conflicting reports as to the finding of iodine in certain waters owe their origin to neglect of this possibility. Some experiments recently made in my laboratory have impressed me very strongly with the easy oxidisability of iodide of potassium; and in a fully aerated water, I should now be surprised to find iodide of potassium,

which I should expect to find oxidised into either iodate or periodate. Bromides and chlorides are not so easily oxidised, but even these salts may undergo oxidation."

The chapters on "Gases and Vapours Dissolved by Water," and on "Urine and Sewage" are useful additions. Attention is called to the fact that most samples of sewage are poorer both in ammonia and in other compounds of nitrogen than a calculation based upon population, average excretions, and known water supply would indicate. The author considers it "by no means impossible that the ureal fermentation is attended with the loss of nitrogen in the form of nitrogen gas."

In the chapter on "Analysis of Total Solids" it is pointed out that certain waters contain some one greatly predominating constituent. Thus the water supply of London yields residues in which carbonate of lime predominates. "These waters are, in fact, very dilute solutions of carbonate of lime (held in solution by carbonic acid)." In stating results, and in classifying waters, such fundamental facts ought, the author maintains, to be brought into due prominence. "Abstraction being made of the carbonate of lime, drinking waters, as a rule, do not exhibit very great variation in the solids contained by them." This idea points to a classification of waters calculated to throw great light both on their domestic and their industrial value.

We need scarcely add that this book is essential to every chemist whose duties may, by any possibility, include the examination of water.

CORRESPONDENCE.

CHEMICAL APPOINTMENTS.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS, vol. xxix., p. 250, "A. Z." very evidently feels annoyed at his advertising twice for a situation and receiving no reply. For my part, advertising is the last "trick" I should try; in saying this I am sure I speak the sentiments of hundreds of qualified chemists, for to what good does it tend? If every chemist were to advertise, and all to receive answers, how many dozen of situations would be vacant each day in the year? As a rule, hasty idlers, or rather applicants, are passed by commercial men in favour of many answers to their own advertisements. The choice of one person "shoving" his abilities before the chemical world is no choice at all; folks wanting a chemist would never look near such. The supply of chemists is greatly in excess of the demand—in the proportion of about 7 to 1. "A. Z." and others ought to "bide their time" like the rest of us, and not try to find a royal road to a vacancy, for to such no royal road exists.—I am, &c.,

CHEMIST.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, April 20, 1874.

Action of Pure Hydrogen upon Nitrate of Silver.—M. H. Pellet.—The author finds that the conflicting results obtained by Houzeau, Regnault, and Russel may be traced to the neutrality of the salt of silver. If the nitrate is perfectly neutral, and if the gas is washed in soda, there is no action upon nitrate of silver at common temperatures. At 80° a slight yellowish grey precipitate is formed at the commencement of the experiment. The

results are the same if the solution of the nitrate is slightly acid. An alkaline nitrate is reduced at common temperatures in proportion to its alkalinity. Elevation of temperature accelerates the action. Hydrogen has no action upon an acid solution either hot or cold. Nitrite of silver cannot exist in presence of nitric acid, especially if heated.

Researches on Soluble Phosphates used in Agriculture.—A. Millot.—The author investigates the phenomenon known as "reduction," or "going back." The reduced phosphate is generally admitted to be a bicalcic phosphate, due to several distinct reactions:—(1) Action of the free phosphoric acid upon the unattacked tricalcic phosphate. (2) Action of phosphoric acid upon carbonate of lime which has escaped the attack of the sulphuric acid. (3) Splitting up of acid phosphate of lime during drying into bicalcic phosphate and free phosphoric acid.—The first of these reactions has been studied by Piccard and Joulie with accordant results. Kolbe, however, announces that at common temperatures phosphoric acid produces only monocalcic phosphate, even in presence of an excess of the tricalcic salt. The author's results agreed with those of Piccard, a crystalline bicalcic phosphate being produced. This salt is, therefore, only formed when the sulphuric acid is deficient, and when there is no longer any free phosphoric acid. Carbonate of lime is never found in dry superphosphates. The author has never been able to trace the splitting-up of acid phosphate of lime in presence of a little free phosphoric acid, which is the case in all commercial phosphates. He believes that where a sufficiency of sulphuric acid has been used, "reduction" does not occur except where phosphates of sesquioxides—iron, aluminium, or manganese—are present. In the superphosphates of commerce, except sulphuric acid has been employed in great excess, the soluble lime just suffices for its saturation. The phosphoric acid is, therefore, probably in a free state. The use of alcohol at 80 per cent has been proposed for separating the free phosphoric acid from the acid phosphate of lime. The results obtained are not exact, because the acid phosphate of lime is partially decomposed by alcohol, with formation of free phosphoric acid.

Direct Determination of the Degree of Intensity of Explosive Mixtures.—M. Chabrier.—The author employs, in the examination of gunpowders, papers coloured with the iodide of starch, and glued down by their margins upon plates of glass of the same size. Upon such a paper is arranged a circle uniformly covered with the powder. The layer ought to be equal; the grains juxtaposed, and not superposed. The weight employed is about 0.5 gramme. The powder is then ignited, and the traces left by its combustion are examined. These traces vary with the nature and condition of the powder examined, but are constant with powders of the same kind, ground in the same manner.

Action of Bromine upon the Bibromo-Succinic Acid—Edm. Bourgoin.—When bromine is allowed to act upon bibromo-succinic acid at a temperature close upon 100°, and in the presence of water, the following products are simultaneously obtained:—Tribromo-succinic acid, bibromo-maleic acid, and tetrabromated hydride of ethylen.

Alcohols Contained in the Sour Waters of Starch-Works and in the Products of the Butyric Fermentation of Glucose.—G. Bouchardat.—These sour waters contain ordinary alcohol and normal propylic alcohol, yielding, on oxidation, propionic and butylic alcohols. Isopropylic alcohol is not present. The proportion of propionic alcohol is more than one-third of the whole quantity. This alcohol seems to be without action on polarised light. The alcoholic products formed during the butyric fermentation of glucose present the same properties as the former.

Determination of Alcohol in Water, Wines, and Saccharine Liquids.—M. Salleron.—A "reclamation of priority" with reference to the memoir of Duclaux on the

application of capillarity to the determination of alcohol. The author proposes to distil a portion of the wine, and to take the weight of 20 drops of the distillate.

General Method for Converting the Alcohols into Nitric Ethers.—P. Champion.—For the methylic and ethylic alcohols, a mixture of sulphuric acid and alcohol at 95 per cent is gradually introduced into nitric acid (2 parts of ordinary sulphuric acid to 1 of nitric acid at 48° B. [?]). Butylic, amyl, and caprylic alcohols require 1 part of nitric acid to 3 of sulphuric acid. Alcohols which form insoluble compounds with nitric acid—such as the cetylic, cerylic, and melissic—are first dissolved in ether, which is then evaporated off at a low temperature. They are then rubbed with sulphuric acid so as to form a homogeneous paste, which is then introduced into the nitro-sulphuric acid. The method is applicable to the industrial preparation of nitro-glycerin. 1 part of glycerin at 30° B. is mixed with common sulphuric acid, taking care that the heat of the liquid shall not rise above 50° C. After it has cooled, the liquid is poured into a small excess of nitro-sulphuric acid. The mixture is effected gradually.

On Phenyl-Allyl.—B. Radziszewski.—An examination of the products obtained on treating with bromine, at temperatures ranging from 140° to 150° C., the aromatic hydrocarbides, especially phenyl-propyl.

On Pyrogallol in Presence of Salts of Iron.—E. Jacquemin.—This paper is noticed elsewhere in the CHEMICAL NEWS.

Colouring Matter of Wines.—The author points out means of distinguishing the colouring matter of wine from three substances frequently employed in the falsification of wines—mauve, cochineal, and *Phytolacca decandra*. Under the influence of oxygen, mauve becomes more and more soluble in water. With the colouring matter of wine, the reverse is the case. Cochineal is best detected by means of the spectroscope. Its absorption-bands are quite different from those of wine. The colour of *Phytolacca* is discharged by nascent hydrogen almost instantaneously, whilst pure wine resists for a considerable time; but, if a little tincture of *Phytolacca* is added to a red wine, it communicates its own instability to the colour of the wine, and the mixture is decolourised ten times more rapidly than if the *Phytolacca* had not been added.

Volatile Acids of Wines.—E. Duclaux.—Wines when sound contain acetic acid in slight amount, mixed with about $\frac{1}{12}$ th or $\frac{1}{15}$ th part of butyric acid. Valerianic acid is found in quantities not exceeding 10 milligrms. per litre, and a higher fatty acid in almost infinitesimal proportions. When wine is affected with the disease known as "*tourné*" or "*pousse*," acetic and metacetic acids are developed in about equal proportions, and to the amount of 2.5 or 2.6 grms. per litre. In the disease of bitterness, acetic acid is developed, along with butyric acid and traces of higher fatty acids. The amount of butyric acid formed is larger than in alcoholic fermentation. The author intends to investigate the disease of "acescence" on a future occasion.

April 27, 1874.

Refrigerating Mixtures.—M. Berthelot.—The thermal effect produced when ice is mixed with bihydrated crystallised sulphuric acid is the sum of three effects, viz., the fusion of the acid and that of the ice, which absorb heat, and the combination of the two liquids, which liberates heat. The numbers obtained in practice are under those calculated from theory, owing to loss through radiation. The author shows from theory that no method of cooling is comparable to vaporisation, and he thinks that much higher temperatures may yet be had by means of it.

Note on the Decomposition of the Work of Forces.—M. Ledieu.—The author specifies the following distinct cases:—(1) Comparison of the work of any force whatever relative to total movement of a material point, with the sum of the works of this same force relative, respec-

tively, to partial movements arising out of a decomposition of the total movement, where the force may be considered as one of the arbitrary components of the resultant of all the actions applied to the point. (2) Comparison of work of the only force capable of producing the total movement of a material point, with the sum of the works of the only distinct force capable of producing respectively the partial movement arising from decomposition of the total. (3) Extension of the two preceding comparisons to cases where the whole of the points of a material system are considered. (4) Comparison of the work of a resultant force relative to movement of a material point along a given trajectory, with the sum of the works of the components. The last alone is dealt with, the author says, in Treatises on Mechanics. He enquires as to the conditions of equality, in cases 1, 2, and 3, between the work relative to compounded motion, and the sum of the works relative to the component motions.

The Production of Gum in Fruit Trees Considered as a Pathological Phenomenon.—M. Prillieux.—The flow of gum is, according to the author, a real disease, which he names *gommoses*. The alimentary substances, placed in reserve in the interior tissues, instead of promoting the plant's growth, are diverted to production of gum, and a portion accumulate, awaiting the instant of their transformation about gummy centres, which seem to act as centres of irritation. The case is analogous to what occurs when an insect deposits one of its eggs in the tissues of a plant, leading to production of a gall, which consists of new cells holding a mass of nutritive matter (particularly fecula) destined, not for the wants of the plants itself, but for the development of the small parasite which appears. The production of gum at expense of the nutritive matter has no other limit than the complete exhaustion of the plant. Scarification of the bark is the best remedy. M. Prillieux's explanation is this:—To cure the disease the materials misappropriated to formation of gum must be brought back to their normal destination. Hence a more powerful attraction for them must be introduced than that of the gummy centres. Now the wounds of the bark necessitate the production of new tissues, and under this strong excitation the reserve matters are employed in formation of new cells, and cease to be attracted in the wrong direction.

Orbit of the Double Star γ of Virgo.—M. Flammarion.—These two suns present the very rare case of a system revolving in a plane precisely perpendicular to our visual ray, so that there is no deformation of the ellipse through perspective owing to our arbitrary position in space. Further, the eccentricity of the double ellipse (which the author constructs) is one of the greatest known, being 0.8715. M. Flammarion estimates the period of revolution at 175 years.

Conclusions to be drawn from Applications of Thermo-chemical Theories to Explosive Substances, especially Gunpowder.—M. Castan.—The author concludes, *inter alia*, that the calorimeter does not serve well for classifying powders, the action of which depends greatly on conditions of use; that we can foresee the limit of growth of artillery power only in the conditions of ballistics, and the service of *matériel*; and that true progress in composition of powder consists, not in introduction of substances containing more work than nitrate of potash, but in application of those which liberate more of it in their formation.

Thermal Conductivity in Rocks and Substances in General.—M. Jannetaz.—The author, after referring to an observation by De Senarmont, which is in discrepancy with his own, describes some experiments with a number of rocks of schistous texture. He always found unequal conductivity in different directions, and he considers that the law regulating the propagation of heat in crystals is only a particular case of one which is general, viz., that heat is propagated more easily along the surfaces, planes, or lines between which there is weakest cohesion. Various non-

schistous rocks and minerals always gave a circle, not an ellipse. M. Fizeau made some remarks connecting the phenomena with those of unequal dilatation in cool-hammered metals.

New Method for Rendering Ships Insubmersible.—MM. Crouzet and Colombat.—At the water line, the hull should be divided by a bridge preventing penetration of the air from the lower to the upper division. If a hole be made in the bottom the water will rush in, but will not entirely fill the compartment, for the air, finding no outlet, will be compressed, and will equilibrate the exterior force. From this point the ship will cease to sink, it will be in the condition of a diving bell.

Elements and Ephemerides of the Planet (127).—M. Renan.

Elementary Law of Electro-dynamic Actions.—M. Moutier. (Extra.)—In his memoir the author starts with considerations enunciated by Ampère and seeks to formulate them from a mechanical point of view, regarding electricity as the result of a vibratory movements of ether.

Observations on Prof. Tyndall's Experiments on the Acoustical Transparency and Opacity of the Atmosphere.—M. Baudrimont.—The author doubts Tyndall's explanation, till better proof be had. One cannot well see how, in calm weather, there should arise sheets or simple vertical columns of air charged very differently with moisture. It is rather horizontal layers than vertical that we should expect to find differing in moisture. Nor does the theory explain sufficiently how layers containing variable quantities of moisture should only be produced at a certain distance from the shore, forming a vertical wall, which gives echoes. The velocity of sound varying with the density of the air, and becoming greater as this diminishes in approaching the surface of the water, a sound-wave going out inclined from above downwards will not move in a straight line, but a curve, which at length becomes horizontal. It is thus deformed and soon extinguished. Sound is due not merely to *evasive* waves going out from its origin, and owing their existence to a propulsion, but requires the concurrence of *invasive* waves produced by the opposite movement of the vibrating substance. When the evasive waves are become horizontal, the invasive waves cannot coincide with them beyond that place, and the sound is consequently extinguished. The vertical layer, to which echoes are attributed, is probably caused by currents, such as are met with in the Straits of Dover; these carrying along masses of air which may differ greatly in temperature, moisture, and density from those they meet in a particular locality. At Bordeaux, when the temperature of the Continent differs considerably from that of the ocean, one observes daily variations of temperature, which are due to masses of air carried along by the water of the river, the course of which changes completely four times every day.

Studies on the Properties of Explosive Substances.—M. Abel. Second memoir (extract).—This is chiefly an examination of the conditions determining detonation of explosive substances, and the circumstances and results which accompany the transmission of the detonation.

Employment of Oxygen Mixed with Atmospheric Air for Respiration.—M. Gaudin.—The author says he obtained results analogous to those of M. Crocé Spinelli's and Sivel long ago, in 1832, when a young doctor directed him to make cholera patients breathe oxygen, and some of them were saved thus. It was proposed by M. Touzet to form an establishment for such treatment as preservative against cholera, but the cholera disappeared and the idea was dropped. The author thinks that divers, coral fishers, &c., might be enabled to remain much longer under water by breathing highly oxygenated air.

Luminous Meteors.—M. Denza presented the programme of the Italian Association for observation of falling stars from April, 1874, to April, 1875. A large num-

ber of individuals, distributed in nineteen different towns, have agreed to make observations five times in the month, but only three hours at a time, viz., from 9 p.m. to midnight, or from midnight to 3 a.m. More than 1000 observations have been made during the past year, and a large number of new showers discovered.

Reimann's *Farber Zeitung*, No. 12, 1874.

Ungumming Silk.—For every pound of silk to be treated $\frac{1}{4}$ lb. of soap is dissolved in water, and heated to a boil. The silk is then entered, and worked in the bath for twenty minutes. It is then taken out and placed in a fresh bath containing 3 ozs. of soap to the pound of silk. In this it is placed for twenty minutes, turned round several times, rinsed, and is then ready for dyeing.

There are then receipts for a brown, a black and a rose on silks, the latter produced with saffranin, and cleared with acetic acid.

There is a receipt for a dark blue on cloth—logwood topped with methyl-violet; for a yellow on plush; for a brown on mixed cotton and woollen garments, and for a black on the same material. Next follow receipts for printing a black, brown, bismarck, ponceau, and scarlet on woollen yarns; and for dyeing an orange and a light sea-green on cotton yarns.

No. 13, 1874.

This number contains receipts for a green, a purple, a nacarat, a light and a dark drab on woollen reps.

Purple and Ponceau Mordant.—Dissolve 14 lbs. tin crystals, and 24 lbs. crystallised bichloride of tin in 50 lbs. of hydrochloric acid free from iron, and use the clear.

Then follow receipts for a green and a silver-grey on tweeds, the latter colour being produced with the well-known ink made by extracting logwood, and adding chromate of potash and borax. There are also directions for a Nicholson blue and a ponceau on silk; a peach-wood red, a magenta, three shades of prussian blue, and a light chamois and a chrome yellow on cotton yarn; instructions for finishing silks, and for preparing catechu. The catechu is to be melted at a steam heat, and kept in that state for an hour. It is then poured off from the dregs into a clean pan, mixed with three quarters of its weight of powdered bichromate of potash, kept melted for half an hour, and is then ready for use.

Next follow instructions for weighting—in plain English adulterating—raw silk with mineral matter.

Liebig's *Annalen der Chemie und Pharmacie*.

April 15, 1874.

A Condensation-Product of Glyoxal.—Hugo Schiff.—By dissolving glyoxal in 5 or 6 volumes of concentrated acetic acid, passing a current of hydrochloric acid gas through the solution for fifteen minutes, and allowing it to remain for some time in a warm place in closed vessels, a substance is obtained which, when dry, closely resembles potato-starch. The author has given it the name hexaglyoxal-hydrate.

Improved Air-Bath for Heating Sealed Tubes.—J. Habermann.—Unintelligible without the accompanying illustration.

Products of the Oxidation of Amylum and Paramylum by means of Bromine, Water, and Silver Oxide.—J. Habermann.—By the action of bromine and water upon the carbo-hydrates, and subsequent treatment with oxide of silver, amyllum, like dextrin, yields dextronic acid. Paramylum, similarly treated, yields an acid isomeric, but not identical, with dextronic acid. Gluconic was found to be capable of crystallisation—a point hitherto disputed.

Soda in the Ashes of Plants.—G. Bunge.—The author examines the opinion that soda is not an essential constituent of plants. This view is supported by the experimental cultivation of plants in solutions supposed to be

free from salts of soda, by the qualitative experiments of Peligot on the ashes of a great number of plants, both wild and cultivated, and by his quantitative examination of the ash of the kidney-bean (*Phaseolus Vulgaris*), in which no soda was found after the potash had been removed by means of platinic chloride. The author points out a source of error in Peligot's method. The latter chemist determined the alkalies merely in the aqueous extract of the ash. But in some ashes a small part only of the soda dissolves in water, the larger portion forming insoluble double salts with the phosphates of the alkaline earths, and can only be fully determined in a nitric or hydrochloric extract of the ash. A much smaller proportion of potash escapes detection in this manner. The author adopted the following method for the determination of the alkalies:—The aqueous extract of the ash, in a platinum capsule, is mixed with so much baryta-water that a scum appears on the surface of the liquid after stirring. The mixture is heated and filtered whilst hot, covering the funnel with a watch-glass. The filtrate is then placed in a platinum capsule, treated with a current of carbonic acid to throw down the excess of baryta, heated, filtered, the filtrate evaporated down in a platinum capsule, the residue slightly ignited, taken up in a little water, filtered through a small filter, and the filtrate evaporated to dryness with hydrochloric acid in a small platinum capsule. The alkaline chlorides are ignited and weighed, and separated by means of chloride of platinum. The nitric or hydrochloric solution of the ash is evaporated to dryness in a platinum capsule, the residue re-dissolved with a few drops of nitric or hydrochloric acid and water, mixed with baryta-water as above, and filtered while hot. Ammonia and carbonate of ammonia are added to the filtrate to throw down the lime and baryta, the liquid is filtered, and the filtrate evaporated to dryness in a platinum capsule. The ammoniacal salts are cautiously driven off at the lowest possible heat. As the solution thus treated still retains a trace of carbonates of the alkaline earths, the residue is re-dissolved in water, evaporated down with oxalic acid, heated till all frothing ceases, again dissolved in a little water, filtered, evaporated in a small platinum capsule, ignited, and dissolved in a little water. In case the solution is not clear, it is again passed through a small filter, and the filtrate evaporated down with hydrochloric acid. The alkaline chlorides are ignited, weighed, and then separated by means of chloride of platinum. The author succeeded in finding a very small amount of soda in the soluble part of the ash of the kidney-bean, and a somewhat larger amount in the insoluble part. He detected and determined in like manner soda in the ash of clover, of meadow hay, of strawberries, and of apples.

Oxysulpho-benzid, and Certain of its New Derivatives.—Dr. J. Annaheim.—A very lengthy paper, not suited for abstraction.

Normal Hexylen and Certain of its Derivatives.—Otto Hecht and Julius Strauss.—The author, after reviewing previous researches on hexylen, concludes that the hexylenes from mannite, and from petroleum-hexyl-chloride, as also their parallel derivatives, are not isomeric but identical.

MISCELLANEOUS.

Royal Society.—At the meeting on the 4th inst., the following gentlemen were elected Fellows of the Society:—Isaac Lowthian Bell, F.C.S.; W. T. Blanford, F.G.S.; Henry Bowman Brady, F.L.S.; Thomas Lauder Brunton, M.D., Sc.D.; Professor W. Kingdon Clifford, M.A.; Augustus Wollaston Franks, M.A.; Professor Olaus Henrici, Ph.D.; Prescott G. Hewett, F.R.C.S.; John Eliot Howard, F.L.S.; Sir Henry Sumner Maine, LL.D.; Edmund James Mills, D.Sc.; Rev. Stephen Joseph Perry, F.R.A.S.; Henry Wyldbore Rumsey, M.D.; Alfred R. C. Selwyn, F.G.S.; Charles William Wilson, Major R.E.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of the salts, carbonates, and hydrates of baryta and strontia, and also for improved modes of making baryta and strontia caustic. Edward Thomas Hughes, of the firm of Hughes and Son, patent agents, Chancery Lane, London. (A communication from Louis Gustave Ghilain Daudenart and Edmond Verbert, Rue du Progrès, Schaerbeek, Brussels). September 13, 1873.—No. 3013. To procure the carbonates of baryta and strontia, alkaline earthy chlorides are dissolved in water to 12 or 15 degrees Baumé, and the solution, whether of the chloride of barium or the chloride of strontium, is mixed with hydrate of magnesia in a vessel, which is afterwards closed. The mixture is kept in continual agitation, and subjected to the action of a current of carbonic acid, which, being absorbed by the magnesia, forms a carbonate of this base, and, by the employment of an excess of carbonic acid, the decomposition is rapidly effected, and the alkaline earths produced free from carbonate of magnesia. In practice, the treatment of the alkaline earthy chlorides by magnesia and carbonic acid is effected in two operations; in the first, the magnesia is in excess, which gives, when the reaction is terminated, a liquor containing exclusively chloride of magnesium, which is decanted, and a precipitate obtained, consisting of a carbonate of the alkaline earth and the magnesia employed in excess in a carbonated state, which excess is neutralised in the second operation by an additional quantity of the alkaline earthy chloride. The liquor containing the chloride of magnesium is concentrated by evaporation, and the hydrated chloride of magnesium submitted to the action of steam, superheated to about 300° C., without pressure, so that it becomes completely decomposed, and is in the condition to be rapidly hydrated and carbonated. To manufacture caustic baryta and strontia from their carbonates, the carbonate is mixed with carbon or chalk, and the mixture, whether subjected or not to the action of superheated steam, is heated in a regenerating or reverberatory furnace.

Improvements in the treatment of the liquors used in scouring or cleaning wool. Edward Thomas Hughes, of the firm of Hughes and Son, patent agents, Chancery Lane, Middlesex. (A communication from Louis Gustave Ghilain Daudenart and Edmond Verbert, Rue du Progrès Schaerbeek, Brussels). September 13, 1873.—No. 3014. The object of this invention is—First, to extract the potash in a state of carbonate, which is its most valuable condition, by a process which is at once economical and expeditious; and, secondly, to completely extract the greasy matters which separate from the washing-liquors. The process consists in the employment either of caustic baryta or strontia, the essential characters of which are—First, to effect the entire separation of the greasy matter; secondly, to extract the carbonate of potash contained in the washing-liquors; and, thirdly, to effect the continuous revivification of the baryta and strontia employed.

The process of manufacturing coffeetina. Walter Penn Francis and Francis Addiscott, coffeetina manufacturers, Webber Street, Blackfriars Road, Surrey. September 16, 1873.—No. 3031. Coffeetina is an article of food used either as a substitute for coffee or as an admixture, and is prepared from the stone of the tamarind by extracting the stone or bean from the fruit or pulp, roasting it in cylinders, and grinding it. It then assumes the character of coffee, the novelty of which constitutes the invention.

An improved compound or mixture to be used for lubricating purposes, and for the grinding and reducing of white-lead and colours. George Frederick Cornelius, operative chemist, Merton Abbey, Surrey. September 16, 1873.—No. 3036. The improved compound or mixture consists of milk from cows or other animals in combination with animal or vegetable oils or fatty matters.

Improvements in rendering wood un inflammable, applicable to building and other purposes. Rev. Thomas Jones, St. Austell, Cornwall. September 16, 1873.—No. 3037. The invention consists in rendering wood for building and other purposes un inflammable by impregnating it, by pressure or otherwise with a solution or composition of tungstate of soda in water, and then painting it or not, according as it is to be exposed to the weather or not. By these means the wood is rendered harder by the process, and, the inventor considers, is also less liable to decay.

Improvements in the manufacture and treatment of beer in order to preserve it and to restore it when it has become sour. Alexander William Gillman and Samuel Spencer, Castle Brewery, Saint George's Road, Southwark. September 17, 1873.—No. 3056. For the purposes of this invention, the inventors employ a soluble salt of sulphurous acid, particularly the white of potassium, sodium, ammonium, or calcium, in combination with a chloride or other soluble salt of calcium, or the precipitated oxide of calcium, or the carbonate of potassium, sodium, and ammonium, in the manufacture and treatment of beer, in order to preserve it, and to restore it when it has become sour.

Improvements in the manufacture of fertilising substances and in apparatus therefor, and in the means for preventing the escape of offensive odours during such manufacture and from slaughter-houses, rendering-tanks, and the like. William Robert Lake, of the firm of Haseltine, Lake, and Co., patent agents, Southampton Buildings, London. (A communication from Jacob J. Storer, Boston, Massachusetts, U.S.A.). September 18, 1873.—No. 3070. This invention relates to improvements in the manufacture of fertilising substances, and in deodorising cylinders and processes, to be employed in treating blood and animal offal for such manufacture, and in treating the blood, offal, and other refuse of slaughtering, packing, rendering, and similar establishments, so that all offence may be avoided.

Improvements in the treatment of phosphates of iron and alumina for the purpose of obtaining certain useful products therefrom. Peter Spence, manufacturing chemist, Manchester. September 18, 1873.—

No. 3071. This invention consists in treating phosphates of iron and alumina for obtaining phosphate of lime and caustic soda.

A new blue dye or colouring matter. Charles Denton Abel, Southampton Buildings, Chancery Lane, Middlesex. (A communication from Robert Gottheil, civil engineer and chemist, Berlin). September 19, 1873.—No. 3080. According to this invention, the oils distilled from tar are neutralised by an alkali, washed, and again distilled. The oils containing carbolic acid, creosote, or naphthaline are treated with weak lye to remove the carbolic acid or creosote, and are then combined with strong caustic lye, and subjected to oxidation. By this means, a dye-stuff or colouring matter is produced, which, after separation by filtration and washing, is dissolved in an acid, filtered, and again precipitated by the addition of potash, soda, or ammonia, and freed from any residuary oil by alcohol. The dye thus produced furnishes a blue colour, insoluble in alkalies, ammonia, soap, or alcohol, but soluble in dilute acids.

Improvements in the manufacture of alkali. Henry Deacon, Appleton House, Widnes, Lancaster. September 20, 1873.—No. 3092. This invention relates to the "finishing" of the "salts" obtained in the manufacture of alkali. At present these "salts" are "finished" by being calcined in reverberatory furnaces. Now this invention consists in causing heated air to pass through the said "salts" when at an elevated temperature.

Improvements in extracting and recovering the oils, resins, and colouring matters of manufactured or waste fabrics, or from the raw materials of cotton, linen, wool, silk, or other similar substances, and in utilising the same. George Mackay, Edinburgh. September 25, 1873.—No. 3129. The feature of novelty which constitutes this invention is the extraction and recovery of oils, resins, and colouring matters from fabrics or fibres by boiling with an alkali, after which the foreign matter is allowed to settle, the liquid drawn off, the oils and colouring matters utilised by acid, and the precipitate washed and mixed with ochre or other matter to form a paint, and with salt of lead to form a varnish, these being dissolved in a suitable solvent, or the precipitate with saponified alkali and colouring matter may form printing-ink.

Certain modifications and improvements in coating iron and steel with certain metals, with special application to coppering or covering iron ships with an adherent and protective coating of a less oxidable metal; and, in general, coating large or small pieces of iron and steel, and particularly iron ships, with copper; and in apparatus for that purpose. Frédéric Weil, engineer, and Farnham Maxwell Lyte, chemist, Paris. September 25, 1873.—No. 3136. The features of novelty of this present invention consist—First. In the application of an alkaline battery, whether used in wells or by means of any other form of porous jars or vessels placed in contact with, or immersed in, a metallising alkalino-organic bath. Secondly. In the preparation of the iron to be metallised by means of an acid bath followed by an alkalino-organic bath. If desirable, we dispense with the acid bath or the alkalino-organic bath or both, or substitute for one or the other of these a simply organic and non-alkaline bath made with glycerin or other organic material or an organic salt, neutral alkaline, or acid, even an alkaline non-organic bath applied hot if required before the acid bath. Thirdly. The coppering of ships by means of our process described. Fourthly. The metallising any large or small pieces of ironwork by the process above specified. Fifthly. The particular form or forms of apparatus we have described in the illustration of our improved process as applied to iron ships.

A new liquid polish for cleansing and brightening painted, varnished, glazed, and metallic surfaces. Jean François Chevalier, Lyons, France. September 26, 1873.—No. 3137. This invention relates to a liquid polish compounded of water, hydrochloric acid, aluminocalcareous matter, and ivory-black, applicable for removing tarnish and producing a brilliancy on painted, varnished, glazed, and metallic surfaces.

Improvements in the purification of sugar, molasses, and saccharine juices, and in the regeneration of part of the substances employed, and also in the preparation of manure from the residues thereof. Jean Marie Onésime Tamin, M.D., Chancery Lane, Middlesex. September 26, 1873.—No. 3151. The invention consists in a process of purifying sugar, molasses, and saccharine juices by the use of soluble metallic silico-fluorides. Also in a method of utilising the whole residuum of the said purification in producing a new manure. Also in a process of regenerating the primitive silico-fluoride used in the above purification, and in the utilisation as manure of the part remaining after the said regeneration.

NOTES AND QUERIES.

Adulteration of Oils.—I should esteem it a favour if you or any of the readers of the CHEMICAL NEWS can inform me of any decisive colour-test by which 5 to 10 per cent of bleached cotton-seed oil can be detected in lard oil. I do not think so small a percentage would have much effect on the colour or specific gravity of lard oil, still it would, in a commercial point of view, be of importance, as it might enable the falsifier of the oil to underseil the producer of the genuine oil.—CHEIRON.

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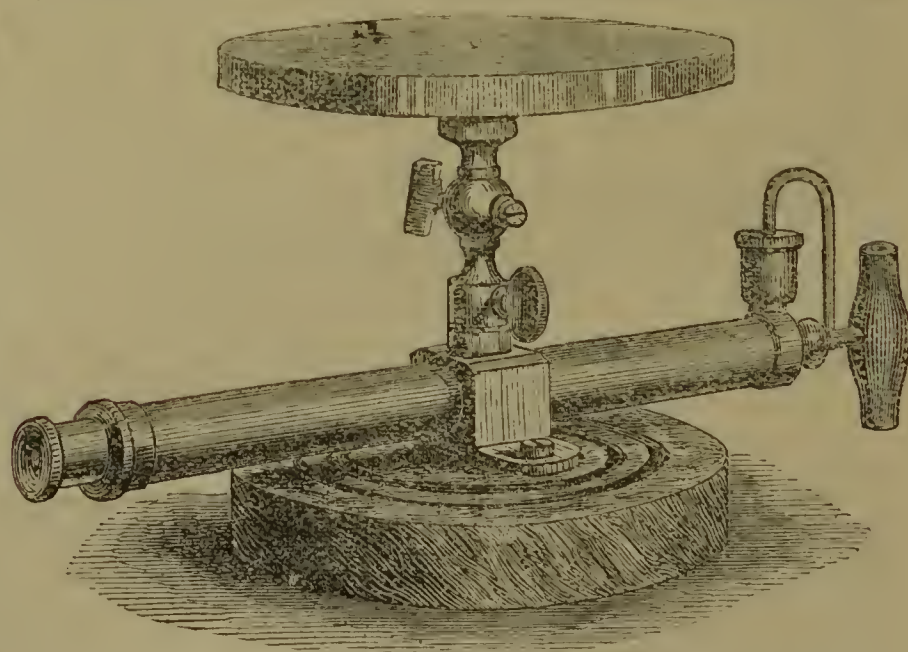
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THE CHEMICAL NEWS.

VOL. XXIX. No. 761.

ON THE PHYSIOLOGICAL ACTION OF LIGHT.*

By JAMES DEWAR,
Lecturer on Chemistry, University of Edinburgh,
and JOHN G. M'KENDRICK, M.D.,
Demonstrator of Practical Physiology, University of Edinburgh.
(Concluded from page 271).

III.

SINCE the date of our last communication, we have continued our investigations, with the following results:—

1. The light from a beam of uncondensed moonlight, though of weak intensity, and almost entirely free from heat rays, is still sufficient to alter the electro-motive force of the nerve and retina.

2. We have examined the phenomenon in the eyes of the following animals:—

(1.) The common newt—*Triton aquaticus*; (2.) The goldfish—*Cyprinus auratus*; (3.) The rockling—*Motella vulgaris*; (4.) The stickleback—*Gasterosteus trachurus*; (5.) The common edible crab—*Cancer pagurus*; (6.) The swimming crab—*Portunus puber*; (7.) The spider crab—*Hyas coarctatus*; (8.) The hermit crab—*Pagurus Bernhardus*; and (9.) The lobster—*Homarus vulgaris*.

The general results with the eyes of these various animals were similar to those we have previously described. The eye of the goldfish and rockling, both sluggish fishes, were found to resemble each other, inasmuch as the variations in the electro-motive force were slow, and in this respect they presented a marked contrast to those of the active and alert stickleback, the eye of which was very sensitive to light.

The experiments on the eyes of crustacea are of importance, because they show that the action of light on the compound eye is the same as on the simple eye, namely, that it alters the amount of the electro-motive force of the sensitive surface. The eye of the lobster was found to give a deflection of about 600 galvanometrical degrees, the scale being placed at a distance of about twenty-six inches. Light produced a variation in this deflection of about 60 degrees,—that is, about 10 per cent, the largest amount of variation we have yet observed in any eye. It was also demonstrated that the effect of light, diminished in intensity by distance, was exactly what was observed in the case of the simple eye. For example, at the distance of one foot, a variation to the extent of about 100 degrees was observed. At a distance of ten feet, with 1-100th part of the amount of light, the effect was not one degree, but 20 degrees, or one-fifth of the total amount observed at one foot.

3. The action of light on the electro-motive force of the living eye in cats and birds (pigeon and owl) has been observed. In our earlier experiments, we found great difficulty in observing sensitiveness to light in the eyes of mammals and birds, when these were removed with the utmost despatch from the orbit of the animal immediately after death. This was evidently owing to the fact, that the sensibility of the nervous system in these animals disappears quickly after the withdrawal of healthy blood. It, therefore, became necessary to perform the experiment on the living animal. This was done by first putting the cat or bird under the influence of chloroform, then fixing it by a proper apparatus so that the head was perfectly immovable, and lastly removing the outer wall of the orbit with as little disturbance to the ciliary vessels as possible. The optic nerve was now cut, the transverse section

directed upwards, and the clay points of the electrodes were now adjusted, one to the transverse section of the nerve, and the other to the cornea. With these arrangements, we at once found a strong current extremely sensitive to light.

4. The effect was traced into the optic lobes of a living pigeon under chloroform. The following were the results of this observation:—*a.* When one pole was applied to the left optic lobe, and the other to the cornea of the right eye, a deflection was obtained which was sensitive to light; *b.* When the pole was removed from the right eye and applied to the cornea of the left, a smaller deflection was obtained, also sensitive to light; and *c.* When light was allowed to impinge on both eyes, while the one pole was in contact with either eye and the other with the left optic lobe, the result was nearly double that produced by the impact of light on one eye alone, either right or left. These effects may be explained by the decussation of the optic nerves in the optic commissure.

5. The eye of a snake* was examined, and in its action resemble that of the frog.

6. We are therefore now in a position to state, that the law of the variation in the electro-motive force of the retina and optic nerve, holds good in the following groups of the animal kingdom, Mammalia, Aves, Reptilia, Amphibia, Pisces, and Crustacea.

7. Many experiments have been made which prove that the psychophysical law of Fechner, alluded to in previous communications, is not dependent only on preception in the brain, but in part on the structure of the eye itself. The effects which occur on, during, and after the action of light on the retina, also take place after the eye has been removed from all connection with the brain. Thus the law of Fechner is not, as has been hitherto supposed, a function of the brain alone, but is really a function of the terminal organ, the retina.

8. We have also employed a new method of registering galvanometrical variations, which may be of service in many physical and physiological researches. This consists in placing at the proper distance from the galvanometer, instead of the ordinary graduated scale, the surface of a cylinder covered with paper, and moving on a horizontal axis by clock-work. The spot of light reflected from the galvanometer mirror is rendered more precise by having the shade of the galvanometer lamp blackened over the entire surface, with the exception of a spot about three millimetres in breadth, in the centre of which a line or cross is made of soot. The image of this line or cross is of course reflected by the mirror upon the cylinder. When the cylinder is set in motion by the clock-work, the spot of light may be accurately followed by the hand of the observer, after a little practice, with a fine brush moistened with ink. The cylinder we employed performed a complete revolution in eighty seconds. This time was divided into four equal parts, each representing twenty seconds, by four lines drawn transversely at equal intervals across the paper on the cylinder. The first space, between lines one and two, represented twenty seconds, in which the eye was in the dark, and in which the electro-motive force is represented by a straight line; the second space, between lines two and three, represented twenty seconds, during which the effect of the impact of light took place, and in which the variation of the electro-motive force is indicated, either by a curve to the right or to the left; the third space, between lines three and four, represented twenty seconds of continued action of light, during which the electro-motive force gradually rises; and lastly, the fourth space, between lines four and one (the point of starting), represented twenty seconds, during which the electro-motive forces at first rises on the withdrawal of light and afterwards sinks rapidly.

* Read before the Royal Society of Edinburgh.

* Kindly sent us by Mr. Bartlett, of the Zoological Gardens, Regent's Park. We have also to acknowledge the kindness of Mr. Lloyd, Manager of the Crystal Palace Aquarium, who supplied us with three specimens of *Eledone* (a cuttle-fish, to represent *Mollusca*), but none arrived alive.

THE ADULTERATION ACT.

CORRESPONDENCE BETWEEN THE LOCAL GOVERNMENT
BOARD AND MR. J. A. WANKLYN.

OUR readers may be aware that some time ago a controversy took place between Dr. Redwood and Mr. Wanklyn concerning certain samples of bread, which the former of these chemists maintained were sophisticated with alum, whilst the latter declared them free from such adulteration. Dr. Redwood having cited the results obtained by Dr. Hardwicke in confirmation of his own, Mr. Wanklyn, in a letter to the *Times*, under date March 5, 1874, objected to this gentleman as a competent authority. The "attention" of the Local Government Board having been "called" to this letter they consider it inconsistent with the testimonial of competence which Mr. Wanklyn had previously given to Dr. Hardwicke, and wrote for an explanation.

Mr. Wanklyn, in reply, points out that to certify a man competent for the routine duties of a public analyst, is far from implying him able to act as a referee between two chemists of long experience and acknowledged standing. He also maintains that the "detection of small portions of alum in bread is too uncertain, too difficult, and too costly to be required of the public analyst," and doubts whether the addition of 4 grs. of alumina to a 4-lb. loaf can be fairly regarded as an adulteration.

Mr. Wanklyn's first plea we consider irresistible. To take a perfectly analogous case, every sane man will admit that a medical graduate might be perfectly qualified and fit to practise, with benefit to the public, and yet not entitled to adjudicate on a moot point between two of the heads of his profession. With Mr. Wanklyn's last contention we are unable to agree. We believe that the smallest addition of alum acts injuriously, by depriving the bread of a portion of its phosphate of potash. Still, we are aware that Mr. Wanklyn's view is no subterfuge put forward for the occasion, but a doctrine which he has consistently maintained. Under these circumstances we were even more surprised than pained to find that the Local Government Board, in a second letter, pronounce Mr. Wanklyn's explanation unsatisfactory, accuse him most gratuitously of insincerity, and finish by stating that—"they must decline to accept in future any certificate of qualification given by him with regard to appointments requiring their approval!" By way of illustrating the high value they, in turn, set upon sincerity, the Local Government Board sent a copy of their second letter to the Town-Clerk of Middlesboro' unaccompanied by the rest of the correspondence, and without any explanation! Such facts, we think, speak for themselves too forcibly to require any comment.

ANALYSIS OF JERUSALEM COPROLITES.

By H. B. YARDLEY.

THE following is the analysis of coprolites reported to have been sent over from Jerusalem (the exact locality I do not know). The sample was given me already ground, and I was informed that it came over so in bags. I have not seen a sample of the *whole* coprolites, so do not know but what the large excess of sand may arise from insufficient washing. As will be seen from its analysis, it would be of little or no use as an article for the manufacture of artificial manure.

Moisture, &c.	.. .. .	9.41
Sulphur ..	.. .. .	2.22
*Phosphoric acid ..	.. .. .	11.05
†Carbonic acid ..	.. .. .	2.33
Sulphuric acid ..	.. .. .	3.87
Lime ..	.. .. .	13.40
Oxide of iron ..	.. .. .	4.25
Sand ..	.. .. .	53.30

99.83

* Equal to tribasic phosphate of lime, 24.12.

† Equal to carbonate of lime, 5.29.

REMARKS ON A PAPER BY
MR. E. C. C. STANFORD, ENTITLED
"ON COMMERCIAL ANALYSES."

By E. F. TESCHEMACHER and J. DENHAM SMITH.

IN the *CHEMICAL NEWS*, vol. xxix., pp. 190 to 193, we find inserted a paper read before the Glasgow Philosophical Society, Chemical Section, entitled "On Commercial Analyses," by E. C. C. Stanford, F.C.S., to which our attention has been directed, and which we may at once say we should not have noticed had not the author gone out of his way to remark, injuriously, on a memoir of ours which appeared some six years since in the *CHEMICAL NEWS*, and which has, to our knowledge, never been questioned, even by Messrs. Chalmers and Tatlock, whose conceptions of the importance of the City of Glasgow we then ventured to banter, and whose opinions as to the necessity of the purity of the salts of platinum used in estimating potash, we also ventured to contest.

Looking, however, more carefully at this production of Mr. Stanford's, which he has styled "On Commercial Analyses," to which he quickly betakes himself, instead of "On Commercial Analysis," the abstract question, which—however important—he has barely glanced at, yet which is the subject he intended to discourse on, we are tempted to review some statements of an author who, by his own act, has made himself fair game for us, and hence this ink-shed.

The Glasgow analysts lauded and magnified Glasgow, and our author now tells us that "the number of samples passing through the hands of the analytical chemists of Glasgow alone must be enormous; and that he "can bear strong testimony to the remarkable accuracy with which these analyses generally are performed," statements the chemical public will gladly welcome as showing a vast improvement in Glasgow during the past six years; for in 1868 Messrs. Chalmers and Tatlock were impelled to inform the same Philosophical Society—"In Glasgow, at least, an accurate and uniform method of estimating that base (potash) is of the utmost importance, as . . . unpardonable discrepancies constantly occur with regard to the results obtained by chemists of standing and experience." A subject on which, at the time, we gladly admitted these gentlemen to be fair judges, for their "experience had extended over a period of many years, during which they had conjointly made thousands of potash determinations," all of which were necessarily wrong, "since the gist and key-stone of their new process for estimating potash was the purity of the platinum used," and, as they most justly stated, that "pure platinic chloride solution is not the rule but the rare exception, false results must be alarmingly numerous." It is also true that we found ourselves compelled to demur to these alarming statements, and to point out that "true and accurate results depended on manipulation;" a statement which, despite Mr. Stanford's sneer, is the plain and hitherto unquestioned truth.

Mr. Stanford having thus re-vindicated the "remarkable accuracy" of the Glasgow analysts of the present day, proceeds to tell his readers what the analyst should do, and what he should not do; and in virtue, we must assume, of an instinct which would be of singular value to an analyst, says "I heard of a case some time ago in which samples of a cargo of coprolites guaranteed 62 to 63 per cent, were drawn and sent to four chemists, all eminent. One made the strength 56 per cent, another 57 per cent, another 58 per cent, and the other 62 per cent, the latter being right." The instinct which enables this gentleman to decide in this *ex cathedra* style, which of four analyses of coprolites is the right one fails, by the law of natural compensation, to be supplemented by the grammatical instinct, which many a less favoured man possesses, who must be sorely puzzled to determine in the paragraph above quoted the nature of the substance described in

these six percentages, and how, out of four, a "latter" is possible, whether right or wrong.

As to these coprolites, there is no evidence adduced to prove whether Mr. Stanford is right or wrong. He may be right, but, *prima facie*, no analyst would expect this to be the case.

Further remarks now follow, which, were we to notice, would virtually amount to a repetition of much that has been said, till we come to the assurance that—"Some chemists still cling to the inaccurate method of simply precipitating the tribasic phosphate of lime by ammonia, and the precipitate may contain in addition, everything precipitable by ammonia; it is generally, therefore, too high." "May contain," "is generally too high," forsooth! Is not this critic chemist enough to know that "must contain" and "always too high" is the only language he can use? for, be it remembered, throughout he is speaking only of bone-ash, coprolites, and mineral phosphates. All we need say on this mode "that some chemists still cling to" is that we should have held it had not been practised for a generation or more, were it not that we note its re-appearance in the pages of the CHEMICAL NEWS and elsewhere from time to time, and that we have a strong suspicion—well-nigh amounting to certainty—that this antique method has been employed, not so long ago, by a professor of chemistry—no self-dubbed professor—but a professor of chemistry in a Scottish university, to determine the amount of tribasic phosphate of lime in a sample which both he and we examined with widely differing results. Nor were we surprised when our clients questioned our accuracy on the ground of our difference with an University Professor, whom we esteem as a good chemist, but found to be a sorry analyst—terms which, *pace* our author, are neither interchangeable nor synonymous. He then proceeds—"Others adopt Fresenius's process, which gives results a little too low." These "little too low results" prove to be no less than 2 per cent too low; for he further informs us that "a convocation of chemists at Magdeburg agreed that it, Fresenius's process, could be made sufficiently accurate by the addition of 0.1 to every 5 per cent of tribasic phosphate of lime found." Why is it, we may ask, that Convocations seem to be so prone to pass ridiculous and stultifying resolutions? Fancy a convocation of chemists engaged in vamping up an analytical process acknowledged to yield, not merely erroneous results, but erroneous to the extent of no less than "two per cent." Our ancient friend "which some chemists still cling to" is well-nigh as accurate as this one sanctioned by convocation; whilst we maintain, that whatever may be sanctioned in Germany and approved in Glasgow, there is no analyst of repute in London who would not scout the notion of employing in his laboratory any method involving an error of 2 per cent, despite the authority of all the convocations or general assemblies that ever agreed upon silly resolutions. There is, however, "balm in Gilead," for we are glad to be able to add that the magnesian process for determining phosphoric acid is *accurate*. We by no means affirm that the original process invented by Dr. Fresenius will yield accurate results, and the inventor would doubtless be the first to deny such an assertion; but we do say that the magnesian process, worked out in detail by competent analysts, impatient of inaccuracy, and jealous of their reputation, will yield *absolutely reliable results*. The present is neither the time nor place to describe our own modification of this most excellent mode of determining phosphoric acid, but we shall be most willing to publish it in detail, should it be desired, in the CHEMICAL NEWS.

Mr. Stanford now quits the phosphates for a time, and devotes his attention to "potassium salts," *i.e.*, mixed salts of potash and soda; and here we are troubled to divine his meaning when speaking of what it pleases him to term "discrepancy," *i.e.*, difference in the amount of potash reported by various chemists. He adds: "It probably arises from the use of alcohol in addition to

platinum chloride, whereby a portion of the soda (*sic*) salt is not unfrequently thrown down and weighed with the potassium salt."

We beg permission to condole with Mr. Tatlock on his patron, who, at the earliest opportunity, misquotes him, saying—"Mr. Tatlock introduced the use of platinum chloride solution instead of alcohol, in an excellent paper read before this Society in 1868;" whereas Messrs. James Chalmers and Robert R. Tatlock expressly say "most practised analysts digest the residue in strong aqueous solution of platinic chloride," which is both sense, and a disclaimer by these gentlemen of a discovery Mr. Stanford attributes to Mr. Tatlock.

Mr. Stanford then ventures to state—"In the paper referred to, Chalmers and Tatlock show the great importance of using perfectly pure platinum and the difficulty of obtaining it; and that ordinary spongy platinum will give a result 2 per cent too high in chloride of potassium." Hazy language this; and not hazy only, but not founded on fact, for in our "Remarks" on this paper of Messrs. Chalmers and Tatlock, in which memoir of ours *we prove, and prove by a series of experiments in detail*, that "the use of perfectly pure platinum," instead of being of "great importance" is of *no importance*, and that "ordinary spongy platinum will not give results 2 per cent too high."

In spite of having read our paper proving these analysts to have been mistaken in what they term "the very key-stone of their process," Mr. Stanford does not hesitate to describe this process of theirs as "the best which has yet appeared on the subject, and if the process is followed as described, I repeat from long experience, it is rigidly accurate. I speak strongly on this point because the process was afterwards criticised in the CHEMICAL NEWS by Teschemacher and Smith, in which they kindly attributed all the inaccuracies to the chemists of Glasgow, and all the perfect results to their own process, which involves the use of alcohol and its attendant errors." How can a process be "rigidly accurate" which is wrong in its very key-stone? And why should he "speak strongly" when this process was none of his, be it good or bad, unless impelled by the irrepressible impulse that seems to animate Glasgow chemists to uphold the infallibility of the brotherhood. As for "the inaccuracies of the Glasgow chemists," it was the inevitable inference from the statement of Messrs. Chalmers and Tatlock that "pure platinum was essential to accuracy," so that, if they were right, every analysis of potash salts anterior to the appearance of their paper in 1868, must have been wrong. Whilst, as to "the use of alcohol and its attendant errors," we are unable to comprehend how potash can be estimated by platinum *without* the use of alcohol.

Not content with the foregoing, Mr. Stanford, with a disingenuousness which brings its own punishment, says, speaking of us, "the authors convict themselves, as in one of their own experiments undertaken to test the process, they actually show an error of 1.4 per cent of a potash salt," an imputation on our accuracy—

"That palter with us in a double sense,
That keeps the word of promise to our ear,
And breaks it to our hope."

This "one experiment undertaken to test the process"—or rather they, for two are quoted by us, but one suppressed by Mr. Stanford—were made not "to test the process," *i.e.*, our process, but the mistaken statement and belief of these Glasgow analysts, that ordinary spongy platinum was unfit to be employed in making solution of chloride of platinum wherewith to estimate potash, as it yielded results some "2 per cent too high," and "which could not be brought much nearer to the truth;" this they characterised "as an alarming state of things," and condemned spongy platinum as unfit for this use. Now these statements proved to be moonshine, and to pin Mr. Stanford to the point we quote the very words we made use of at the time. "We dissolved this spongy platinum just as it came from the makers, with-

out any attempt at preliminary purification, and as this solution, when of equal strength to ours, was somewhat darker and redder, it probably was not quite so pure. This solution with 1000 grs. of No. 1 = 10 grs. of nitrate of potash, duly acidified with hydrochloric acid, yielded 24.10 grs. of the platinum salt = 9.860 of nitrate of potash, *being a loss instead of a gain, and the worst result of our tests*; whilst 1000 grs. of No. 2 solution = 8 grs. of potash salt, yielded, with this "impure" solution of platinum 19.35 grs. of platinum salt = 8.003 of potash salt, a result which should satisfy the most exacting chemist." The italics are recent. This is what our candid critic calls convicting ourselves of error. Mr. Stanford, therefore, not only perverts our statements, instead of quoting the very words employed—which is the recognised duty of a writer who impugns the alleged facts of another, and suppresses, not only the fellow experiment on the subject of spongy platinum, but also the other experimental results of our modification of the platino-potash process which prove its accuracy and reliability,—but has ventured to make the general statement against us, which we must be pardoned for repeating;—"The authors convict themselves, as in one of their own experiments, undertaken to test the process, they actually show an error of 1.4 per cent of a potash salt." Here he doubtless thought himself safe from detection; he might rely on none of his readers but ourselves taking down the CHEMICAL NEWS of 1868 to verify his assertion, and he almost escaped us under the cloud of his vague general statement, for we sought long before we found the place in our memoir where he has perverted the object of our experiments, which was simply to prove or disprove the assertion that ordinary spongy platinum will give a result 2 per cent too high, whereas these experiments showed in the one case a loss of 0.140 in the potash salt, and in the other a gain of 0.003 in the potash salt, which latter we again repeat "is a result which should satisfy the most exacting chemist."

We have now to complain of a second, but a very minor, offence committed by Mr. Stanford, who has thought proper, without seeking our permission, to print portions of a business letter not intended for publication, and addressed to some clients of ours with instructions to submit the same to Mr. Stanford, who had thought right, on insufficient grounds, to question the accuracy of an analysis made by us on account of these gentlemen; which letter Mr. Stanford has attributed to Mr. Teschemacher instead of to us. As he has taken this liberty, and printed such portions of the letter as he fancied would serve his purpose, we now challenge him to publish this letter *in extenso* in the CHEMICAL NEWS, and promise, subject to the consent of the Editor, that a note he addressed to our Mr. Teschemacher in reference to this same letter shall appear in the pages of the next number of the journal. We may now take leave of Mr. Stanford.

Before we close these remarks, we would so far trespass on the patience of our readers as to say a few words respecting the process for estimating potash which is to be found in the CHEMICAL NEWS, vol. xvii., pp. 244—246. The object of this paper was to point out that the conclusion arrived at by Messrs. James Chalmers and R. R. Tatlock as to the necessity of the absolute purity of the solution of platinum employed, and which they term "the key-stone of their process" was erroneous, and that "accurate results depended on manipulation." We also showed that the pulverulent condition of the double salt of platinum and potash was an ordinary source of error, and that it was requisite to obtain this double salt in the state of orange crystalline scales, which admitted of rapid and perfectedulcoration, to ensure accurate results. But, as some of our readers may not have this number of the CHEMICAL NEWS at hand, we recapitulate the leading and essential points of our process:—

"I. Dilution of solutions.

"II. Use of chloride of platinum in large excess, about 20 grains of metallic platinum to 10 grains of salt examined.

"III. Heating of solutions, and evaporation so conducted as to obtain the potassic salt in a crystalline scale-like condition.

"IV. Evaporation on water-bath to a pasty condition.

"V. Drenching with spirit whilst salt and dish are hot, and, instantly, on removal from water-bath.

"VI. Washing by decantation, and avoiding breaking down of the crystalline precipitate.

"In practice, the process is a rapid one from beginning to end, requiring about two hours; less time, indeed, than was frequently expended in merely washing the dense pulverulent precipitate we denounce as liable to many sources of error."

We have used this process for many years without being able to devise any improvement in it, but other analysts may have advantageously modified it; if so, we should be glad to hear from them of such improvements, with a view to their adoption in practice, and publication in a reprint of the method we are now contemplating.

London.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 18th, 1874.

Dr. FRANKLAND, F.R.S., &c., Vice-President, in the Chair.

THE names of the visitors having been announced, and minutes of the previous meeting read and confirmed, Messrs. E. Cleminshaw, J. Bayne, J. M. Glassford, W. Sharman, and T. H. Tono were formally admitted Fellows of the Society. The following names were read for the first time:—Messrs. F. W. Bayley, James Forbes, Jun., Edwin Lawson Kock, M.D., Frederick Baden Benger, and Louis Siebold. For the third time—Messrs. W. H. Wilson, Richard Apjohn, M.A., W. A. Carter, B.A., James Kilroe, Thomas Garside, James Henry Davies, George Christopher, Charles Benjamin Caswell, and F. Stocks, who were balloted for and duly elected.

The first paper, "*On the Action of Chlorine, Bromine, &c., on Isodinaphthyl*," by W. SMITH, was read by the Secretary. The author, after referring to his published account of the mode of preparation of isodinaphthyl, $C_{20}H_{14}$, by the action of heat on naphthalene, proceeded to describe the action of chlorine on it. The product, $C_{20}H_{10}Cl_4$, is an amorphous powder, soluble in alcohol and ether, but insoluble in water. The corresponding bromine compound was not obtained, the action of bromine on the isodinaphthyl giving rise to a white amorphous substance freely soluble in ether, less so in alcohol, and insoluble in water. Apparently, it is a mixture containing the compound $C_{20}H_7Br_7$. The sulphonic acid sublimes at a low temperature in slender needles, which are readily soluble in water. Its solution is fluorescent, as are also those of its salts.

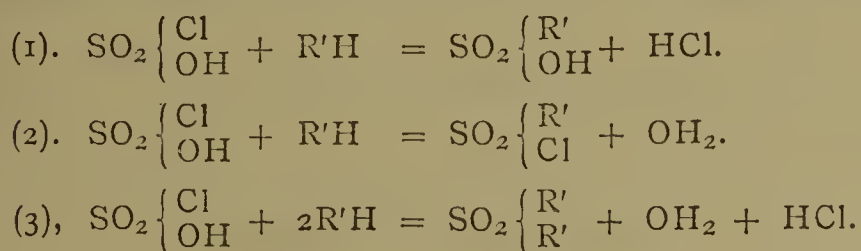
Dr. FRANKLAND, in thanking the author, remarked that this research exemplified the general law of the aggregation of atoms under the influence of heat, resulting in the production of molecules of greater density.

Dr. WRIGHT called attention to the fact that the action of heat on naphthalene in removing two of hydrogen gave a different body from what was produced if the naphthalene was first brominated, and the bromine then removed.

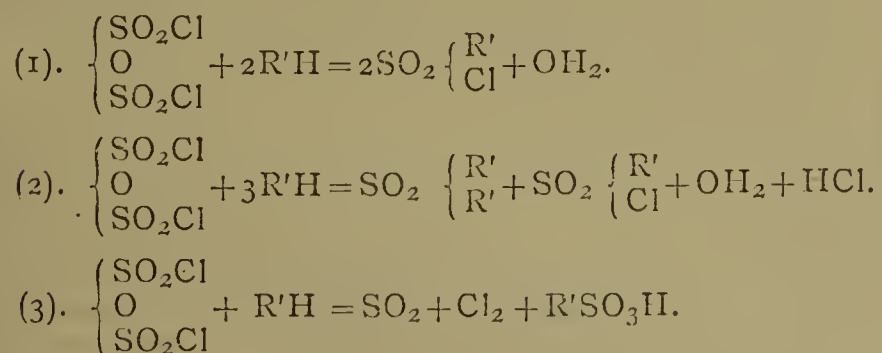
Dr. ARMSTRONG then read four "Communications from the Laboratory of the London Institution."—No. XIII., "*On Coal-Tar Cresols and some Derivatives of Para-Cresol*," by H. E. ARMSTRONG and C. L. FIELD. Commercial "cresylic acid," boiling at 190° to 205° C., was heated for about 20 hours at 100° C. with an equal weight of concentrated sulphuric acid, and the product, after removal of the excess of sulphuric acid, converted into barium

salts by neutralisation with barium carbonate. An excess of barium hydrate was now added to the solution, which caused the precipitation of the basic barium salt of para-cresol-sulphonate. The filtrate was found to contain the potassium salts of phenol-parasulphonic acid, phenol-metasulphonic acid, and a cresol-sulphonic acid, from the latter of which a cresol was obtained which appeared to be pure ortho-cresol. The basic barium para-cresol-sulphonate was converted into the corresponding potassium compound, and then heated in sealed tubes to 160° C. with dilute hydrochloric acid, whereby it splits up into potassic hydric sulphate and pure para-cresol boiling at 198° to 201°. With nitric acid, para-cresol yields two nitro-cresols, one a yellow volatile oil which becomes solid at 0°, the other a crystalline solid; by the further action of nitric acid, these are converted into the dinitro-cresol melting at 83°. Nitric acid converts potassium para-cresol-sulphonate first into potassium nitro-para-cresol-sulphonate, and then into dinitro-cresol. The dibromo-nitro-cresols obtained from the volatile nitro-cresol and from the nitro-para-cresol-sulphonate appear to be isomeric. Bromine converts potassium para-cresol-sulphonate first into mono-, then into dibromo-para-cresol-sulphonate, and finally into tribromo-cresol.

"No. XIV. "On the Action of the Chlorides of the Acids of the Sulphur Series on Organic Compounds," by H. E. ARMSTRONG and W. H. PIKE. The action of chlorhydric sulphate on numerous compounds has been examined by the authors, in order to ascertain what circumstances govern the three possible modes of action of this chloride.



It is found, for example, that when the chloride is added to well-cooled toluene, the product consists almost entirely of toluene-sulphonic acid; if the temperature is allowed to rise, less sulphonic acid is produced, and at the same time a considerable quantity of toluene-sulphonic chloride and toluene sulphone, $(\text{C}_7\text{H}_7)_2\text{SO}_2$. When, however, the toluene is added to the chloride, the proportion of the two latter products is far greater. The action of this chloride on benzene, xylene, cymene, iodo-benzene, chloro-benzene, cyano-benzene, dibromo-benzene, bromonaphthalene, aniline, and acetanilide has also been examined by the authors. With the pyro-sulphuric chloride, the reaction may take place in the manner indicated by the equations:—



The chlorine, however, is never evolved as such, but produces chlorinated compounds; phenol, for example, yields a mixture of the two isomeric monochloro-phenols and of the two monochloro-phenol-sulphonic acids. The action of the pyrochloride on various compounds has been examined, and it is found that benzene yields all the products required by the above equations; whilst with dibromo-benzene the reaction is chiefly that represented by equation (1).

No. XV. "On the Haloid Derivatives of the Nitro-Phenol-Sulphonic Acids," by H. E. ARMSTRONG and F. D. BROWN. The action of bromine on the potassium salt of

iodo-nitro-phenol-sulphonic acid, previously described by the authors, gives rise to bromo-nitro-phenol-sulphonic acid, $\text{C}_6\text{H}_2\text{BrNO}_2\text{OH.SO}_3\text{H}$, identical with the product of the action of bromine on nitro-phenol-parasulphonic acid. Two isomeric nitro-phenol-sulphonic acids are formed by the action of sulphuric acid on the volatile nitrophenol, which yield two isomeric bromo-nitro-phenol-sulphonic acids when treated with bromine. Further bromination converts both these into the dibromo-nitro-phenol, melting at 117°, whilst nitric acid produces isomeric bromo-dinitro-phenols.

No. XVI. "On the Decomposition of Dichloro-Nitro-Phenol (Melting at 125° C.) by Heat," by H. E. ARMSTRONG and F. D. BROWN. In this reaction the whole of the nitrogen is eliminated in the gaseous state as nitrogen, nitric oxide, and nitric peroxide, whilst three solid products are formed, one of which has been identified as dichloro-quinone. The formation of the latter body confirms the opinion that quinone is a para-derivative, and not an ortho compound (1:2) as formerly supposed.

The thanks of the Society having been communicated to the authors, Mr. E. NEISON read a paper "On the Products of the Decomposition of Castor Oil (No. III., On the Decomposition by Excess of Alkaline Hydrate)." After referring to the discrepancies in the results hitherto obtained by the different chemists who had examined this reaction, the author said that he had made numerous experiments with varying proportions of oil and alkali, conducting the distillation at different temperatures. The results showed that octylic alcohol and methyl-hexyl-ketone are invariably produced, although the proportions in which they occur vary with the circumstances under which the reaction takes place; some octylene was also obtained, but no heptylic alcohol. By oxidation with bichromate solution the alcohol was converted into caproic acid, and is therefore methyl-hexyl-carbinol. An octylene boiling at 126° to 128° C. was also prepared from it by the action of zinc chloride, and the bromide and chloride of the olefine examined. The author purposes to carefully examine the alcohol and ketone formed in this reaction, as well as their derivatives.

The CHAIRMAN then thanked Mr. Neison for his interesting communication, in which he had so successfully elucidated the conflicting statements of chemists who had worked on this subject.

The sixth paper was on "Hydrogen Persulphide," by Dr. W. RAMSAY. Hofmann's compound of hydrogen persulphide with strychnine—prepared by adding a cold saturated alcoholic solution of strychnine to an alcoholic solution of ammonium persulphide,—when finely powdered and added to concentrated sulphuric acid, is decomposed, but the liberated hydrogen persulphide, being of nearly the same density as the acid, decomposes before it has time to separate, and the heat produced by diluting the acid decomposes it. The precipitate obtained on adding a solution of calcium persulphide to dilute hydrochloric acid was found, on analysis, to have a composition varying from H_2S_7 to H_2S_{10} . Hydrogen persulphide is an almost colourless oil, which cannot be distilled even under reduced pressure. Its vapour irritates the eyes, and its taste is very acid and disagreeable. The author finds that its reducing action on organic bodies is much more powerful than that of hydrogen sulphide.

The next paper was on "Suberone," by Dr. C. SCHORLEMMER and Mr. R. S. DALE. After noticing the investigations of this compound which have been already published, and which are somewhat discordant, the authors state that the suberone which they prepared from pure suberic acid possessed the properties ascribed to it by Tilley. On fractioning the crude product, the first portion consisted of hexane, the suberone distilling at 179° to 181° C. It has an agreeable odour, and its molecular formula is $\text{C}_7\text{H}_{12}\text{O}$. Nitric acid converts it into the next higher homologue of suberic acid, a crystalline substance, $\text{C}_7\text{H}_{12}\text{O}_4$, melting at 103° C. Its silver salt is only sparingly soluble but the barium salt dissolves readily

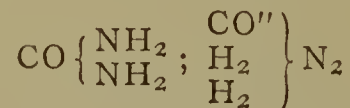
and crystallises from its solutions in transparent tables. The calcium salt is very characteristic, being less soluble in boiling than in cold water. Although this acid has the same composition as the pimelic acid obtained by Hlasiwetz and Grabowsky from camphoric acid, its properties and those of its salts are very different; the authors propose, therefore, to call the new acid the α -pimelic.

A paper, "*On the Action of Nitrosyl Chloride on Organic Bodies; Part I., On Phenol*," by Dr. A. W. TILDEN, was then read by the Secretary. In this action the phenol is oxidised to quinone, which is then converted into chlorinated quinones, the nitrosyl chloride suffering reduction not merely to nitric oxide, but being actually converted into ammonium chloride. The phenol was dissolved in about twice its weight of glacial acetic acid, and nitrosyl chloride passed in in the gaseous state. A deep purple colouration was first produced, which afterwards changed to reddish brown, whilst a crystalline matter was deposited, which, on examination, proved to be chloranil. The solution contained an amorphous nitrogenous substance, besides ammonium chloride and a small quantity of chloranil.

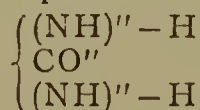
The Chairman having thanked the author in the name of the Society, Dr. D. TOMMASI read three communications in French, the first of which was a description of "*An Apparatus for Determining the Moisture and Carbonic Anhydride in the Air*." This consists of a flask of a capacity of 8 or 10 litres, furnished with a movable cover, into which are inserted two stopcocks, a thermometer, and an oil-manometer. The apparatus is placed in a large box, and surrounded with cotton-wool; after removing the cover, a metallic cylinder containing calcium chloride or potassium hydrate is introduced, the cover replaced, and the stopcocks opened. A current of air is now passed through the apparatus, the stopcocks are closed, and in a few minutes the manometer is read off by means of a telescope, the amount of aqueous vapour or carbonic anhydride being indicated by the greater or less elevation of the column of oil.

The next paper was "*On a Method for Determining Ozone in the Presence of Chlorine and Nitric Oxide*." The apparatus employed consists of two glass tubes, furnished with stopcocks at the bottom, into each of which is introduced an equal quantity of a normal solution of potassium ferrocyanide. The tubes are closed with corks furnished with bent tubes, one of which is in connection with an aspirator, the other dipping into the solution. By this means a current of the gas to be examined can be passed through each of the solutions; in one case, however, it is previously passed through a tube containing platinum-black or manganic peroxide to decompose the ozone. On titrating the contents of each tube with potassium permanganate after the experiment, one will give the total amount of ferricyanide produced by the ozone, chlorine, &c., whilst the other merely gives the result due to the chlorine, &c., without the ozone; from these the amount of ozone can readily be calculated.

The third paper by Dr. Tommasi was "*On the Constitution of Urea*." The author thinks that neither of the formulæ—



generally employed can express the constitution of urea, as the 4 atoms of hydrogen are not all equally replaceable by alcoholic radicals, no compound urea being known which contains more than 2 molecules of an alcohol radical; he therefore proposes the formula—



The compounds produced by the action of cyanic acid on compound ammonias the author considers to be not compound ureas, but derivatives of ammonium cyanate.

A note "*On the Restitution of Burnt Steel*," by S. L. DAVIES, was then read. The author finds that burnt steel

can again be re-steeled or re-carbonised by dipping the red-hot metal into a mixture of resin oil with one-fourth residuum from the paraffin stills, then re-heating and cooling in the ordinary way.

"*On the Action of Earth on Organic Nitrogen*," by E. C. C. STANFORD. The author, after alluding to the efficacy of charcoal in retaining the organic nitrogen of decomposing organic matter, gives details of the results of his experiments on mixtures of earth and decomposing animal matter, from which it appears that the earth is but an indifferent drier, and that the mixture continuously loses nitrogen, which is evolved principally under the form of ammonia; moreover the earth does not act as an oxidiser, and no nitrification takes place.

Dr. FRANKLAND remarked that the action of charcoal was very different from that of dry earth; the sea-weed charcoal, when mixed with fæces or urine and allowed to dry, retaining almost the whole of the nitrogen. When decomposition of nitrogenous matter was in the direction of putrefaction, ammonia was always produced, but, at the same time, much of the nitrogen passed off in the elemental state.

The last paper was on "*Aniline and its Homologues in Coal-Tar Oils*," by Mr. W. SMITH. On examining "red or anthracene oils," "creosole oils," "ordinary coal naphtha," and the black spent acid obtained in the purification of benzol, the author detected aniline in all, the latter containing an appreciable quantity. The aniline in the acid from the treatment of the heavier naphtha was purer, and the amount greater, than from the other spent acids.

This the last meeting of the session was finally adjourned at a late hour until November next.

NOTICES OF BOOKS.

The New Chemistry. By JOSIAH P. COOKE, Ewing Professor of Chemistry and Mineralogy in Harvard University. London: H. S. King and Co.

THIS work forms one volume of the so-called "International Scientific Series." On what account it has received a name so unpleasantly suggestive, and what constitutes internationality in a set of scientific books, we do not pretend to decide.

Professor Cooke's object, as he informs us in his preface, is "to give to the philosophy of the science a logical consistency by resting it on the law of Avogadro." No more striking illustration of the revolutions in scientific theory can well be imagined than that a doctrine scarcely considered twenty years ago as lying within the domain of chemistry at all, should now be put forward as its fundamental principle. It would, indeed, seem as if chemistry were now studied under the auspices of physics, and that the boundary-line of the two sciences was the favourite region for research. It is, of course, from the very nature of the human mind, impossible to present facts free from theories, generalisations, and explanations. Too often, indeed, these, if carefully examined, consist merely in giving a name to the unknown something. We are able to see through a pane of glass, and we "explain" the fact by saying that it possesses the property of transparency. An equivalent of an element unites with one equivalent only of another, and we explain this again by applying to it the word "univalent." It is by no means our author's intention to convey to his readers chemical facts further than as they may serve to illustrate the doctrines which he is upholding. But what he does attempt—to give a view of the chemical theories of the day—is ably performed. It is a work which may be safely recommended "to an intelligent, though not professional" reader, and which the professional chemist also, whether he accept its views or not, will do well to study.

Cocoa and its Manufacture, with Remarks on the Working of the Adulteration of Food Act, 1872. By J. HOLM. London: G. Rivers.

THIS pamphlet, the substance of a paper read before the Society of Arts, will no doubt command attention during the present inquiry into the operation of the "Adulteration of Food" Act. The author gives us an interesting sketch of the culture of the cacao-tree, the preservation and preparation of its fruit, the conflicting analytical results obtained by different authorities, and the adulterations of the manufactured article. Among these he mentions animal fats, not probably of the finest kinds, chicory—that most unhappy consequence of the great continental war at the beginning of the century—catechu, and certain mineral matters, such as red lead, peroxide of iron, and sulphide of mercury. These adulterations he considers have baffled analytical chemists. The detection of catechu, lead, and mercury cannot offer any insuperable difficulty. "That the admixture of sugar and farina are adulterants" (*query*, is an adulteration) the author indignantly denies. To a certain extent this may be admitted. Still we must remember that farina is, next to woody fibre, the cheapest product of the vegetable kingdom, and of all the substances eaten by man the most insipid.

The author himself speaks elsewhere of "the addition of animal fat to cover the use of a poor cocoa, and enable the addition of an excessive quantity of sugar and farina." This is the danger of legalising declared admixtures, that the purchaser has no notion of the quantity of the inferior article which has been used. The grocer is allowed to sell mixtures of coffee and chicory. How is the public to tell whether the vile root forms 10 or 90 per cent of the mixture? Even in the latter case the seller is before the law blameless. Quite the same with cocoa. If we once sanction the presence of farina, all that is required of the maker is that he shall add cacao nuts "enough to swear to." That the "soluble cocoas" too commonly sold in England are about as appetising as a cup of bill-sticker's paste sweetened with treacle must be admitted with regret. According to the author, the reason why chocolates like those of France and Spain, which require scraping and boiling, find little favour in this country, is the national dislike of trouble. This fear of trouble is the cardinal sin of the English *cuisine*, and it plays admirably into the heads of "pushing" tradesmen, by whom we are "taken in and done for." That the present Adulteration Act is inefficient we cordially admit, and we trust that the Parliamentary Committee now sitting will be able to see the way to its amelioration.

Results of an Experimental Enquiry into the Mechanical Properties of Steel of Different Degrees of Hardness, and under various Conditions, Manufactured by Charles Aspelin, Esq., Westanfors and Fagersta Works, Sweden. By DAVID KIRKALDY. London: Published by the Author. 1873.

IN this volume we are presented with the results of an interesting investigation conducted by Mr. Kirkaldy at his Testing Works at Southwark. The steel submitted to test was made at the Fagersta Works, and was sent over as manufactured in ingots, bars, and plates, whilst the samples were further prepared under Mr. Kirkaldy's immediate direction. As the enquiry was left entirely in the hands of this gentleman, we have the best assurance that the tests were selected and applied with that judgment which his long experience would dictate. The samples when properly prepared were submitted to tensile strains, compressive strains, transverse stresses, twisting stresses, and shearing stresses. The results are carefully tabulated in forms which will be consulted with great interest by the Mechanical and Civil Engineer.

In connection with some of the questions which such enquiries suggest, we may remind the reader of a very elaborate investigation on the mechanical properties of Swedish iron and steel, conducted a few years ago by

Professor Styffe of the Polytechnic School of Stockholm. His results were published in the *Fernkontorets Annaler*, and the Swedish paper was translated into English by Mr. C. P. Sandberg.

Looking at such enquiries from the standpoint of a chemist, we cannot help regretting that the samples which are submitted to these careful mechanical tests, should not also be in all cases examined chemically. It is well known that the mechanical properties of a metal are often materially affected by the presence of even a very small proportion of foreign ingredients. In the case of these Swedish steels, investigated by Mr. Kirkaldy, we know the proportion of chemically-combined carbon, because it is the custom in Sweden to classify steels according to their degrees of hardness as represented by their percentage of carbon, which is generally determined by Eggertz's colouration-test. But it would have been of great interest to carry the chemical enquiry further, and to determine at least the proportion of phosphorus and sulphur in each sample.

Daily Bulletin of Weather Reports (Signal Service United States Army); With the Synopses, Probabilities, and Facts for the month of September, 1872. Washington: Government Printing Office.

THE War department of the United States has a well-organised meteorological section. Observations are made simultaneously at a number of stations thrice daily, and the results are telegraphed to Washington. Here they are recorded, collated, and forecasts, as we should call them, of the weather to be expected during the ensuing twenty-four hours are telegraphed back to the stations. The work before us contains daily tables of the barometric pressure in 72 stations, of the temperature, the humidity, the direction and velocity of the wind; the state of the clouds, upper and lower, with the direction of the upper currents of air if observed; the rainfall during the last 8 hours; and remarks on the general state of the weather. A daily chart gives a graphic representation of the same facts.

On another page we find the forecasts for the next day, and the facts showing how far the predictions issued on the previous day have been verified. A brief synopsis of the results is placed daily at the service of the public press. We need scarcely say that documents of this kind, drawn up daily with the utmost care, and published in monthly volumes, must be of incalculable service for the promotion of meteorological science. Such a collection of data affords means for tracing the action of causes supposed to influence the weather, and for verifying theories, such as no private observer could otherwise command.

CORRESPONDENCE.

THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—The Fellows of the Chemical Society have just received a most curious circular, signed by the Secretaries, requesting us to exert ourselves to promote the sale of our periodical, the expense of which has become so considerable since the abstracts of foreign papers have been inserted. Allow me to suggest at once a return to the old *quarterly* issue of the journal, giving nothing but the papers read before the Society. This would suit the funds of the Society much better, and would be all that the Fellows of the Chemical Society require.

The show of papers read is miserably small it is true, but if the days put aside for "lectures" were not allowed to interfere with the regular meetings, and papers of a more practical character were encouraged, not only would the number of contributors of papers be much increased, but the Society would be better able to withstand the alluring influences of the rapidly rising Chemical Section of the Society of Arts.—I am, &c.,

EQUIVALENT.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, May 4, 1874.

Depth of the Magnetised Layer in a Bar of Steel.—M. Jamin.—The author conceives the bar as made up of threads, or elementary chains, formed of small magnets joined by their contrary poles. The contrary poles facing each other are concealed, so that the threads are inactive except at their extremities where there are free poles. The threads lie parallel to the axis in prismatic bars, but, as the free poles repel each other, they expand by diverging and terminate at different points of the free surface where they develop reactions. In each element of surface the intensity is proportional to the number of poles and the square of the detaching force. The total number of threads on the total quantity of magnetism is equal to the sum of the intensities for each element, that is, to the sum of the square roots of the detaching forces. There are four points to be examined:—(1) The sum total of the threads which traverse the middle zone. (2) The law of their distribution in this zone. (3) The sum total of the intensities distributed in the free surface. (4) The distribution of these intensities. The author experimented with four series of steel plates, having thicknesses of 1, 2, 3, 4, m.m. and 1 metre long, by 50 m.m. broad. He traced, parallel to the length, four equidistant lines, dividing them into 5 bands of 50 m.m. breadth, then at distances 0, 50, 100 m.m. from the extremity he measured the detaching forces of a small proof contact suspended from a balance. He concludes (in general) from his experiments that in a thick bar of steel there is no magnetisation at the centre; that the elementary threads only begin to appear at a distance of 3 or 4 m.m. from its surface, but that they are multiplied and contracted more and more in the free surface. The law of decrease of magnetic quantity agrees with the formula $\frac{F}{ay}$, F being the intensity at the superficial point (it is $\frac{F}{a}$ at distance 1, $\frac{F}{a^2}$ at distance 2, &c.). The totality of magnetism condensed in a plate of thickness y is—

$$m = 25 \left(1 - \frac{1}{(1.6)y} \right).$$

This quantity is *nil* for $y=0$, increases very rapidly up to 1 and 2 m.m., very slowly thereafter. For an infinite thickness $m=25$, hardly more than for 3 or 4 m.m.

Observations on M. Faye's Recent Note on Pouillet's Calculation of the Cooling of the Solar Mass.—M. Ledieu.—The author makes some strictures on M. Faye's conclusions.

Researches on Hydrogen (continued).—M. Favre.—The fixation of gaseous hydrogen by palladium is quite different from its fixation by platinum black. In the latter case, the hydrogen is not chemically changed; in the former it undergoes an allotropic modification before combining. The alloy of hydrogen and palladium is explosive, and when hydrogen is fixed by palladium to saturation, there is always incandescence (on contact of air) with liberation of aqueous vapour. Considering that ordinary hydrogen, in being fixed by platinum black, liberates about 20,000 calories, one may find in the thermal phenomena accompanying the condensation of this body, and combination of *active* hydrogen with palladium, the expression of the quantity of heat leading to allotropic transformation of ordinary gaseous hydrogen. We have analogous cases in the transformation of oxygen under the electric effluvia, the change of red phosphorus into ordinary phosphorus, &c.

Report on Apparatus for Transfusion of Blood, Presented to the Academy by M. Moncoq and M. Mathieu.—Question of priority.

Illumination of Opaque Bodies by Neutral or Polarised Light.—M. Lallemand.—If a bundle of polarised rays (the ordinary spectrum from a prism of spar, *e.g.*) fall on an opaque body of dull surface without reflecting power, the results got on analysing with a Nicol may be grouped in three categories, according as the opaque substance is white, coloured, or black. In the first case, the light diffused shows no sign of polarisation—whatever the incidence may have been. The diffusion is here a phenomenon of isochromatic fluorescence. The superficial molecules of the body vibrate in unison with the incident rays, and emit neutral light of the same colour and of proportional intensity. If the body be coloured, the diffused rays have no more an intensity proportional to that of the existing rays. Some of the colours are very bright, others are considerably weakened. The diffused rays are partially polarised, and some almost completely. A variable portion of the incident ray excites vibration of the superficial atoms, and developes a fluorescence generally isochromatic; another part of the ray experiences a sort of molecular reflection, constituting veritable diffusion. There is a simple propagation, in all directions, of the incident luminous movement, so that, in a determinate direction, the vibration of the ether in the diffused ray is always the projection, in a plane normal to this ray, of the incident vibratory movement. Dark bodies (as platinum black, oxide of copper, black smoke, &c.) diffuse the spectrum like coloured bodies; but the fluorescence developed by the incident rays is always isochromatic and equal for all the rays; that is, the superposition of all the rays diffused by fluorescence would re-constitute a part of the incident white light. Here the fluorescence is weak, and the truly diffused light which has retained polarisation is relatively very intense. The author considers these phenomena to confirm his theory of the illumination of transparent bodies.

Gravitation, Cohesion, and the Distance of the Centres of Molecules.—M. West (extract from memoir).—Gravitation and cohesion are manifestations of the same force. As we know the law of this, also the dilatation of a mass of nitrogen under the influence of one calorie, we may construct, in terms of the distance of the molecular centres, an expression of the quantity of work necessary to overcome the cohesion of the mass of nitrogen. Since, further, this quantity of work is a datum of experiment, we find, by putting this datum equal to the expression referred to, and solving the equation, that the distance of the molecular centres (which is the same for all gases in normal conditions of temperature and pressure) is equal to 665×10^{-9} metres. In water, at the temperature of maximum density, the distance is 62×10^{-9} metres. In all chemical equivalents of the series where the weight of the equivalent of hydrogen is 10 grms., the number of the molecules is invariably 761×10^{-15} .

Influence of Spring Heats on Phylloxera vastatrix.—M. Cornu.—The author considers the middle of April as the average date of waking of the insect in Herault, Montpellier and neighbourhood, and the Bouches-du-Rhône.

Phenomena Observed in the Satellites of Jupiter.—M. Flammarion.—The principal fact here mentioned is that the third satellite, which usually appears white like the others when crossing the planet, was seen dark, and darker than the grey band on which it appeared. It was nearly as dark as the shadow of the second satellite. This fact (noticed rarely before) the author explains by a variable atmosphere in the satellite; the brightness varying with the quantity of clouds present. When the atmosphere is clear the satellite appears dark. Secchi, again, supposes permanent spots on the satellite. In another observation, the author noticed the shadow of the second satellite, contiguous with that of the third, grey, while the latter was black on the same white background.

Might not this, he asks, be due to the refractions produced by a considerable atmosphere surrounding the second satellite?

Reflecting Power of Flames.—M. Soret.—The author concludes from his experiments (made with highly concentrated sunlight and various kinds of flames) that carbon retains its reflecting power at very high temperatures; how high is not known with certainty.

Studies on the Properties of Explosive Substances.—M. Abel (extract from third memoir).—This treats of the influence of solids and liquids mixed with explosive matters.

The Physiological Phenomena Observed in High Regions of the Atmosphere.—M. Barraud.—The author does not believe in a sort of sickness peculiar to aëronauts such as has been lately described. In some ascents he experienced, at a barometric pressure of 373 m.m., great sickness and faintness. But he attributed it to the fact of his being at the lower part of the balloon, and so exposed to the action of impure hydrogen, which escaped through its excess of pressure. It was a sort of poisoning. When the boat was attached at a distance of 4 m. from the lower end of the balloon, the outflow of gas did not reach the voyagers, and all they experienced was a difficulty in breathing, acceleration of pulse, weakening of voice, and the effects of cold.

Fumeroles of Nisyros, and some Products of the Eruption in 1873.—M. Gorceix.

Mechanical Aptitude of Horses.—M. Sanson.—From observations by M. Fritz on traction of mowing and reaping machines in America and Europe, it is clear that the average mechanical aptitude of horses for useful work rises to over three millions of kilogrammetres per day, or more than 83 kilogrammetres per second—a considerably higher estimate than those made by Poncelet, Morin, and others. In a walking pace the weight of the body is always supported by at least two legs; but in the trot and the gallop there is, between each application, an instant in which the body is suspended in air, and has to overcome gravity. The author has estimated that the mean effort necessary in trot and gallop is about 0.10 of the weight of the body; while for walking pace it is only 0.05. Now the farm horses about Paris weigh on an average 651 kilogrammes, and give about 2,500,000 kilogrammetres of disposable or useful work per day of ten hours. They thus give a total force necessary to produce $2,500,000 \div 650 \times 0.05 \times 3600 \times 10 = 3,670,000$ kilogrammetres. M. Sanson shows that the total work of two millions of kilogrammetres, which he had taken in determining the mechanical coefficient of the food, is only the minimum of general aptitude of horses.

Studies and Experiments on the Metallic Sulphides.—M. Berthelot.—A continuation of the author's thermochemical researches. Though interesting and important, the paper is not adapted for abstraction.

Action of Distilled Water upon Lead.—M. Is. Pierre.—When steam is passed through a leaden worm, the water condensed is often charged with lead to such an extent as to appear opalescent, and almost milky. In one experiment 34 litres of condensed water gave on filtration 2.54 grms. hydrated carbonate of lead, or 0.0747 gm. per litre. The filtrate, which was very bright, on treatment with sulphuretted hydrogen gave only doubtful signs of the presence of lead. 1 litre of the filtrate was evaporated after previous treatment with carbonate of ammonia, 0.00375 gm. of a plumbiferous residue was obtained, which took, in contact with sulphuretted hydrogen, the usual colour.

Determination of Clay in Arable Soils.—Th. Schlœsing.—The separation of clay, sand, and calcareous matter by levigation is deceptive, since the last lot, supposed to contain the clay, includes in reality whatever is of extreme tenuity, whether sand, lime, or true clay. Two soils which give the same result by levigation may be ex-

ceedingly unlike if the last lot in the one consists of clay, and in the other of a mixture in which an extremely fine sand predominates. The author takes a sample of 5 grms., previously freed from stones and organic matter, made up into a paste with a little water, and rubbed up with the finger in a capsule. More and more water is gradually added, and the suspended matter is poured off. By constantly adding water and rubbing, nothing remains in the capsule but sand, which is rubbed until it yields nothing more to water, and is then thrown into the vessel in which all the washings and decantations have been united. The coarse sand is now separated in the ordinary manner by decantation and washing, dried, weighed, and the calcareous sand and organic particles determined in the ordinary manner. The fine sand, calcareous matter, and clay are now found suspended in 300 to 400 c.c. of water. Nitric acid is now added in small successive quantities, stirring repeatedly on each addition until the lime is dissolved, and the liquid remains clear. The clay is, in fact, coagulated by the salts of lime formed, but the same clearness is noticed when the soil is quite deprived of calcareous matter. It is due to the presence of free acid. Traces of hydrochloric, nitric, or sulphuric acid have the power of coagulating clay as decidedly as calcareous or magnesian salts. After this treatment with acid the mixture of clay and fine sand is filtered and washed. As soon as the calcareous salts, and the free acid are eliminated, the filtrate passes turbid, and filtration becomes difficult. The clay has then resumed its colloidal property of diffusion in pure water. The whole is then washed out of the filter into a precipitating glass of 2 litres capacity. The amount of water consumed in washing the filter clean is, at most, 150 c.c. Upon the mixture we pour 1 to 2 c.c. of liquid ammonia, and digest for one hour. The glass is then filled up with pure water, stirred, and set aside for twenty-four hours. After this time the amount of fine sand remaining suspended is unimportant. The clay-liquid may then be drawn off by means of a syphon. The residue is washed into a capsule, weighed, and dried. It is fine sand, but is generally confounded with clay. On its surface there is generally found a brown coating which contracts as it dries and separates from the sand. It consists of organic matter rich in oxide of iron. The argillaceous liquid is coloured by a compound humate of ammonia, ferric oxide, and alumina. On neutralising the ammonia, and acidifying slightly, the clay and the organic matter fall together. To separate these two colloids as far as possible, a few grammes of sal-ammoniac are dissolved in the alkaline liquid. The clay coagulates whilst the humate remains suspended. When the liquid has become clarified by standing it is decanted as far as possible, the rest, along with the clay, is thrown on a tared filter, dried at 100°, and weighed. The amount of sal-ammoniac varies with the quantity of humates present. The ordinary determinations of clay in soils are far too high.

Method of Determining Phosphoric Acid.—M. F. Jean.—The author dissolves the phosphatic matter in nitric acid, and the solution separated by filtration from insoluble matters is mixed with a slight excess of ammonia. Citric acid is then added, which dissolves the precipitate formed by the ammonia, and yields a perfectly clear acid solution, which is boiled for some time with acetate of uranium. The yellowish precipitate formed is collected on a filter, washed with boiling water, dried, ignited, and weighed. It contains 20.04 per cent of phosphoric acid. The filtrate, on examination with molybdate of ammonia, is found free from phosphoric acid.

Influence of the Presence of Nitrogen in Textile Fibres on the Direct Fixation of Aniline Colours.—E. Jacquemin.—This paper has been already noticed in the CHEMICAL NEWS.

Reimann's *Farber Zeitung*, No. 15, 1874.

This number contains a continuation of the directions for dyeing and finishing plushes; receipts for dyeing upon

wool, woollen yarn, or piece goods orange, red, and blue capable of resisting fulling; shades upon wool from red to brown with a mixture of fustic and madder, to which, according to shade, cochineal, logwood, or orchil is added; and a light chocolate upon wool.

Detection of Artificially Coloured Wine.—Solution of blue vitriol, 1 part to 10 of water, if added to genuine wine destroys the colour without turbidity. Coloured wine is turned a violet-blue by the same reagent, and rendered slightly opaque. Baryta-water (1:10) destroys the colour of genuine wine almost entirely, and causes a slight turbidity. Artificially coloured wine is turned violet-blue or a blue green, and is rendered turbid at the same time. It must be understood that an uncoloured wine is necessarily genuine, but that one artificially coloured may still be the genuine juice of the grape.

There are also receipts for a methyl green and a dark chamois on cotton yarn; a reddish drab, a blue-drab grey, and a yellow-grey on silk; a scarlet and ponceau on shoddy, and a bronze on alpaca.

Ménard replaces yolk of egg in tanning and leather dyeing with stearin made up into an emulsion.

Commaille infers from his experiments that corallin is most easily and plentifully formed at 150°. At this temperature 100 parts of phenol yield in six hours 26 of corallin. Of the oxalic acid employed, 72 per cent can be recovered from the mother-liquor. On digesting the mother-liquor with lead oxide we obtain parathionate and thioamylate of lead. On filtration after digestion a fine red compound of lead oxide and corallin separates out. The proportion of lead in this compound is not constant. The commercial corallin has hitherto been taken for an amide of the yellow. Commaille considers this unlikely. Yellow coralline yields a red compound, both with ammonia and other bases, without any rise of temperature. The solution of yellow corallin in ammoniacal water yields the same products of decomposition as the artificial red. Commaille, therefore, considers that yellow corallin is not an acid, as hitherto supposed, and that red corallin is not the amide of the yellow. The quantity of oxalic acid employed is far too large. Corallin yields no definite metallic compounds, but merely coloured lakes.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin,
No. 6, April 13, 1874.

Certain Derivatives of β -Dinitrophenol.—H. Salkowski and G. Rehs.—The authors have obtained and examined β -dinitro-anisol, $C_6H_3(NO_2)_2OCH_3$; β -dinitrophenol, $C_6H_3(NO_2)_2NH_2$; and di- and tri- (?) nitrobenzol from β -dinitranilin.

Constitution of Dinitrobenzol.—H. Salkowski.—A hypothetical paper.

Chloride of Antimony as Reagent for the Salts of Cæsium.—R. Godeffroy.—If the solution of a salt of cæsium, not too dilute, is mixed with a solution of chloride of antimony in concentrated hydrochloric acid a white crystalline precipitate is at once formed, which does not disappear on the addition of hydrochloric acid. The solutions of the other alkali metals yield no precipitate if similarly treated. The precipitate may be collected on a filter, washed with concentrated hydrochloric acid, and re-dissolved in the same acid much diluted. The solution yields on evaporation well-developed, hard, permanent crystals, belonging to the hexagonal system. They may be obtained pure by repeated solution in dilute hydrochloric acid, and re-crystallisation. They contain 33.419 per cent of chlorine, and of antimony 30.531 per cent, corresponding to the formula $S6Cl_3CsCl$. This salt is decomposed on the application of heat, and on treatment with water. It is completely soluble in dilute acids. Charples and Stolba observed a similar reaction of the cæsium salts with stannic chloride. The salts of rubidium, however, give with chloride of tin a precipitate which is very sparingly soluble. The presence of ammonia in the liquid contaminates the double chloride of cæsium and

tin with pink-salt. The reaction with chloride of antimony is not interfered with either by ammonia or rubidium. The liquid must be strongly acid to prevent the precipitation of oxychloride of antimony.

Protamin—a New Organic Base Found in the Seminal Filaments of Rhine Salmon.—F. Miescher.—These filaments are easily separated from the secretion, and contain—Lecithin, 7.5 per cent; cholesterin, 2.2 per cent; fat, 4.5 per cent; albuminoids, 10.3 per cent; and, as its chief constituent, 48.7 per cent of nuclein, an albuminoid free from sulphur and rich in phosphorus. Its properties are acid, and it forms an insoluble saline compound with the base protamin. The latter is composed of—

Carbon	43.72
Hydrogen	8.50
Nitrogen	28.34
Oxygen	19.44
	100.00

or $C_9H_{21}N_5O_3$.

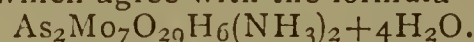
Heat of the Formation of the Oxides of Nitrogen.—Julius Thomsen.—A controversial notice of Berthelot's papers, *Comptes Rendus*, vol. lxxviii., pp. 99, 162, and 205.

Thiobenzyl and Thioaniline.—F. Krafft.—Merz and Weith consider thioaniline as aniline in which the hydrogen of the benzol is replaced by sulphur. It may be regarded as thiobenzol in which hydrogen is replaced by the amid group.

Sensibility of Bromide of Silver to Colours called Chemically Inactive.—E. Schultz Sellack.—A critique on Vogel's paper, *Berichte*, No. 17, 1873, p. 1302.

Aromatic Silicium Compounds.—A. Ladenburg.—The author describes the action of zinc-ethyl upon silicium-phenyl-chloride, and also the silicium-tolyl compounds.

Arsenio-Molybdic Acid Compounds.—Hermann Seyberth.—If a solution of arsenic and molybdic acids is heated to boiling in presence of ammonia for some time, a crystalline precipitate is formed, which after purification gave results which agree with the formula—



The compound dissolves in hot water, and gives with excess of silver nitrate a pale yellow precipitate, and white precipitates with salts of baryta and lead.

Isothionic Acid Amid.—Hermann Seyberth.—The body obtained consisted of—

C	19.20
H	5.10
N	11.20
S	25.60

and agreed with the formula $C_2H_7NSO_3$. It cannot be taurin as it gives off ammonia on treatment with water.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

An improved process for silvering mica for use in the construction of reflectors and reflecting shades. Edward Otto Woerteler, Castle Street, Falcon Square, Middlesex. (A communication from William Marot Marshall, Philadelphia, Pennsylvania, U.S.A.). September 27, 1873.—No. 3152. Mica, free from metallic deposit, is first washed in nitric acid, and then well rinsed in water, after which it is placed in vats of earthenware. The sheets of mica are arranged back to back in pairs vertically and endwise, leaving a small space between each pair, so that only one side of each gets coated. When the mica is properly arranged, the vats are filled up with the following solution, the proportions of the ingredients forming which may be here stated as an example for a small quantity of mica as follows, viz.:—I place 1 oz. of nitrate of silver in a bottle containing 1 quart of pure water, and allow it to thoroughly dissolve. In another bottle, also containing 1 quart of pure water, 1 oz. of glucose is dissolved. When the nitrate of silver is dissolved, a small quantity of aqua ammonia is added; this renders the clear solution muddy; a little more ammonia is then added till the solution again clears. The contents of the two bottles are then mixed, and the whole poured into the receptacle containing the mica, which is then put in a warm place to encourage deposit, and,

when sufficiently coated, is removed from the receptacle, and thoroughly rinsed in water, and hung up to dry, after which it may be coated with spirit-varnish.

Improved pneumatic drainage works for removing and utilising faecal matter. Charles Thieme Liernur, of the firm of Liernur and De Bruyn Kops, engineers, Frankfort on the Maine, Prussia. September 30, 1873.—No. 3168. The invention relates to a process for rendering human excrement useful instead of noxious, by means of pneumatic drainage-works. 1. By arrangement of pneumatic drain-pipes in the street. 2. By street reservoirs. 3. By arrangement of branch-pipes. 4. By using a stopping-valve for branch-pipes. 5. By applying tension-valves to both branch-pipes and main-pipe. 6. By adapting water-closets to my pneumatic drainage system. 7. By the use of a stationary air-pump engine, with "poudrette" attachment, this arrangement being for the purpose of spreading the faecal matter, immediately after its arrival in the central reservoir, in thin layers upon surfaces exposed to the vacuum. The whole being an improvement on my invention for which Letters Patent were granted on May 3, 1869. This improvement being a method of removing human excrements out of houses and cities, and converting them into a dry manure or poudrette with one and the same steam-engine in one continuous unbroken process, employing therefor a system of pneumatic sewerage which admits water-closets, and by which no locomobile engines, waggons, or horses are required in the streets, nor any metal or other valves whatsoever for shutting off the branch-pipes from the main-pipe.

A new disinfectant and oxidising agent. William Whitthred, analytical chemist, Liverpool. September 30, 1873.—No. 3169. When manganese tetrachloride is added to oxidisable bodies it is decomposed, and yields 2 equivalents of nascent chlorine and 1 equivalent of manganese dichloride. I use also the higher bromides and iodides of manganese and other metals. When I treat liquids, such as sewage and impure waters, with the above disinfectants, I sometimes remove from the treated liquid, the metallic chlorides, or bromides, or iodide which they would contain, by the addition to the liquids of alkalies, alkaline carbonates, or the alkaline earths or their carbonates, or by passing the liquids through filters made of the alkaline earthy carbonates alone or mixed with other substances, such as sand and gravel.

Improvements in the preparation of colouring matters, and in the application of the same to the dyeing, printing, and marking of textile and other fabrics. Alfred Vincent Newton, mechanical draughtsman, Chancery Lane, Middlesex. September 30, 1873.—No. 3176. The chief object of this invention is to provide a colouring matter which, when used in dyeing, or printing, or marking fabrics, will produce a permanent stain, impression, or marking, in contradistinction to the fugitive or changeable effects now obtained. To this end a mixture is prepared of extract of logwood, of chromic acid (or one of its salts), and aniline black or aniline blue-black, soluble in water.

Improvements in the production of sulphuric acid. Hermann Sprengel, Gloucester Street, Belgrave Road, Middlesex. October 1, 1873.—No. 3189. In the production of sulphuric acid as now generally adopted, it is necessary to introduce into the chambers jets of steam in order to effect the desired combination of the several gases employed for the production of sulphuric acid. Now this invention relates, first, to the employment as a substitute for a jet or jets of steam, or in conjunction therewith, of water or of acidified aqueous solutions either of sulphuric acid or of nitric acid, the same being converted by means of jets of steam, or by means of jets of air at an elevated pressure, or by any other means, into an exceedingly finely-divided condition of the fluid or into spray. Such finely-divided condition of the fluids employed acting in a manner similar to steam, but forming an economical substitute therefor. One other part of my invention consists in the employment of sulphuric acid in a finely-divided condition or spray for effecting the absorption of the lower oxides of nitrogen contained in, or escaping from, the sulphuric acid chambers. Another part of my invention relates to the employment of sulphuric acid containing in solution nitric acid or the lower oxides of nitrogen or mixtures of the same in a finely-divided condition or spray, so as to utilise the oxides of nitrogen contained therein for the production of sulphuric acid in the sulphuric acid chambers.

Improvements in the production of ozone, and in the application of the same to various useful purposes. John Henry Johnson, Lincoln's Inn Fields, Middlesex. (A communication from Pierre Isidore David, Paris). October 2, 1873.—No. 3190. It is proposed, according to this invention, to apply ozone to the decolourisation or bleaching of organic matters in such a manner as to effect their decolourisation by the gaseous method, whilst obviating the wetting of the matters operated upon. This invention embraces certain processes for the preparation of ozone. 1st process, by chlorine, carbonic acid gas, and ammoniac.—Chlorine in a gaseous state is produced in a closed receptacle by one of the ordinary means. The chlorine obtained is introduced into a receptacle containing the materials to be decolourised; there is then projected into the receptacle containing the materials a rapid current of carbonic acid gas obtained by the ordinary means. The apparatus in which the carbonic acid is produced communicates with another apparatus containing liquid ammonia. The ammoniacal fumes or vapours enter the carbonic acid gas, and are conducted by it into the receptacle. The presence of the ammoniac and carbonic gases neutralises the chlorhydric acid, whilst maintaining and accelerating the decolourisation. 2nd process, by permanganate of lime and sulphuric acid.—This permanganate is obtained by the reaction of bi-oxide of manganese on lime by means of heat. It is placed in a closed receptacle which communicates with another receptacle containing the materials to be decolourised. By gradually pouring sulphuric acid through a tube on to the permanganate of lime, ozonised oxygen is evolved, which passes into the other apparatus, and produces the decolourisation. 3rd process, by phosphorus and acetic acid.—By causing air which has bubbled up through acetic acid, contained in an adjacent receptacle, to bubble up through the water which contains the half-

submerged phosphorus. The receptacle which contains the phosphorus communicates by a tube with the receptacle which contains the materials to be decolourised, and the decolourisation is effected. The bubbling action is obtained by means of an exhaust or blast fan. 4th process, by alum, chalk, and sulphuric acid.—A saturated solution of alum is prepared by elevating the temperature to about 140° or 160° F. To this is added carbonate of lime in powder, in the proportion of about equal weight to that of the alum. A quantity of sulphuric acid, about equal to that of the alum or chalk, is then poured over the whole. Effervescence is produced, and the gas which is evolved is conducted through a tube into a receptacle containing the materials to be decolourised, and effects their decolourisation.

NOTES AND QUERIES.

Oxidising Hydrosulphuric Acid.—Could any of the readers of your valuable paper inform me if there is any cheap and convenient method for oxidising hydrosulphuric acid, (H_2S)?— H_2S .

Filtration on a Large Scale.—(Reply to E. B. M.).—The writer has found the patent filter press made by Messrs. Needham and Kite, of Vauxhall, and described in the "Report of Her Majesty's Commissioners—Exhibitions 1862 and 1867," the most useful apparatus for filtration on the large scale.—H. E. D.

Lime Crucibles.—(Reply to "Delta").—For melting platinum by the oxyhydrogen flame, these can be readily made by scooping out a suitable hollow in a piece of dense quick-lime. A dome or cover can be fitted of the same material, and a channel, groove, or hole be made to admit the flame.—G. A. K.

To Remove Gold Letters from Wire Blinds.—(Reply to J. S.).—Pour a little mercury over the letters, the blind being first placed on a table. Allow this to remain until an amalgam is formed with the gold, to be removed with a small brush. If any varnish be present to interfere with this, apply a little methylated spirit before and after.—G. A. K.

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